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REVISION OF THE CHILLICOTHE TEST-CORE SECTION

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This paper presents a correction in the interpretation of the section of the Chillicothe test-core as given by the present writer in an article published in this Journal (Carman, 1947). The core came from a well 3 miles southwest of Chillicothe on the Hirsh fruit farm. The well was drilled by the Engineering Experiment Station, The Ohio State University, to obtain a core for the determination of the petroleum content of the Ohio shale, foot by foot (Kerr, 1948). The entire core was studied by the writer for the determination of the rock units passed through, and discussed in the 1947 paper. The list of rock units penetrated was given in that paper as follows:

Rock Unit	*Thickness*			*Depth to Base*		
	Ft.		*In.*	*Ft.*		*In.*
Mantle rock	6	—	6	6	—	6
Sunbury shale	1	—	0	7	—	6
Berea sandstone	25	—	6	33	—	0
Bedford shale	91	—	0	124	—	0
Ohio shale	376	—	6	500	—	6
Olentangy shale	64	—	0	564	—	6
Niagaran dolomite	12	—	6	577	—	0

The present paper deals only with the basal unit of the above section, 12 ft. 6 in. thick which in the earlier paper was assigned to the Niagaran dolomite and described as follows (Carman, 1947, p. 53). "The dolomite is bluish-gray to brownish-gray and quite variable in texture. In part it is firmly crystalline and compact; in part of very rough texture with open spaces containing petroliferous staining; at places apparently brecciated as if crushed reef material; the basal 4 feet is largely oolitic dolomite. No identifiable fossils were found in the dolomite but in the porous, crushed reef-rock material there are structures that suggest the compound coral *Favosites* and concentrically laminated masses suggesting stromatoporoids, all greatly altered. Although not absolutely conclusive, the evidence indicates that this dolomite is upper Niagaran." This correlation agreed with the fact that in Highland and Adams counties to the southwest, the Ohio shale rests disconformably on a surface of Niagaran and Greenfield dolomites.

In the spring of 1953, in the studies of another geologist on detrital materials at the disconformable contact at the base of the Upper Devonian shale, the piece of the Chillicothe test-core containing the top of the dolomite was sectioned vertically. This section revealed a fossil entirely against the Niagaran age of the dolomite and led to a very thorough restudy of this lower part of the core with sections and polished surfaces at a number of horizons.

The Olentangy shale overlying the calcareous strata is dominantly blue-gray in color, but with many thin layers of brownish-black shale. The lowest 3 ft. is black and brownish-black shale with a few thin layers of blue-gray shale. The restudy of the 12 ft. of calcareous strata next below resulted in the following described section which is also shown graphically in figure 1.

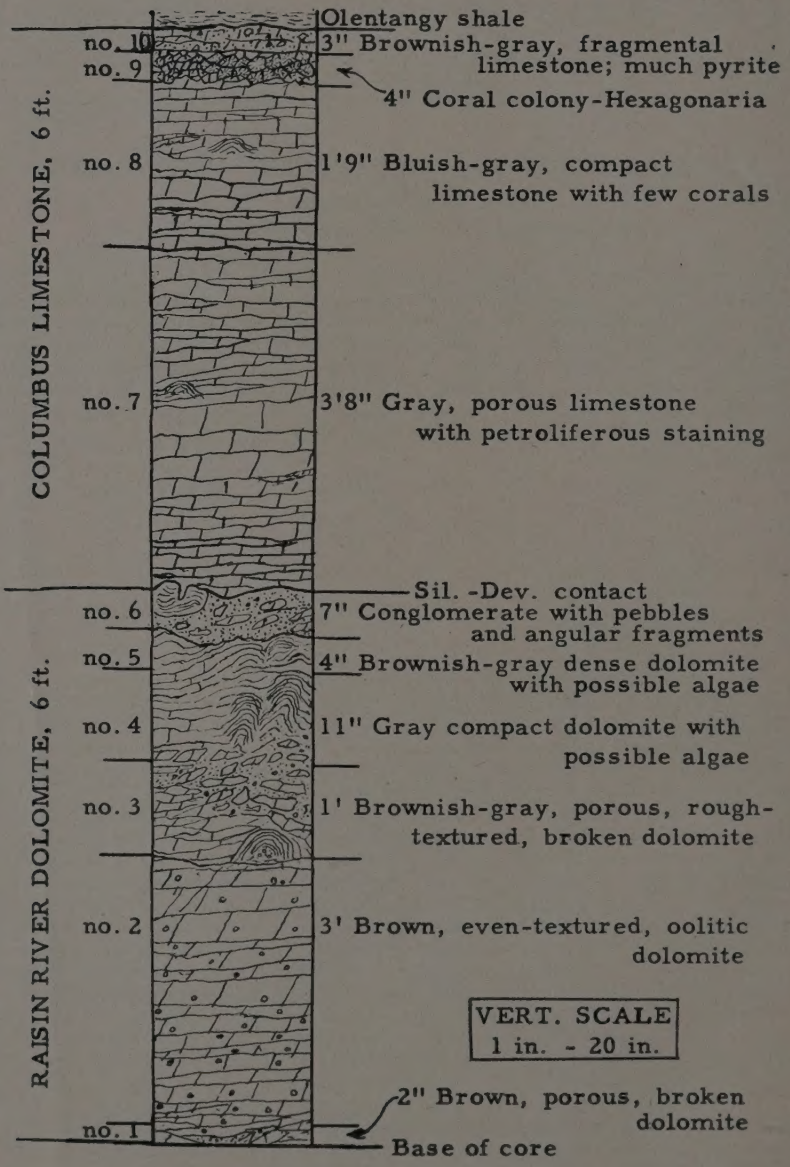


FIGURE 1. Columnar section of calcareous strata below upper Devonian shale

SECTION OF THE CALCAREOUS ROCK STRATA PENETRATED BY THE CHILLICOTHE TEST-CORE BELOW THE UPPER DEVONIAN SHALE

The zones are numbered from the base upward but discussed from above downward.

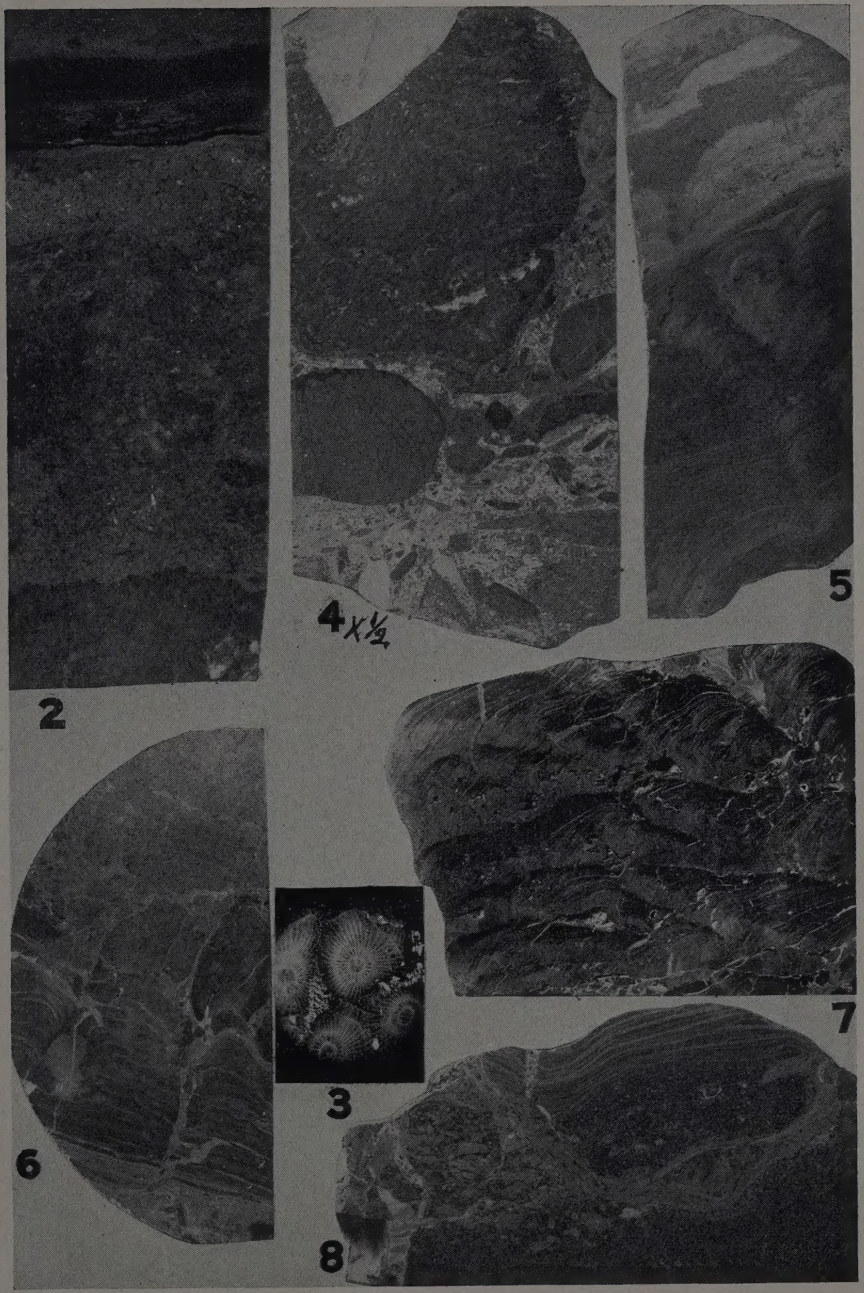
		Thickness Ft.	In.
10.	Gray to brownish-gray, compact, fragmental limestone with much pyrite. Composed of small calcareous fragments firmly cemented in a matrix of finer grain. The polished section shows small coral tubes, a horn coral, and a compound Favosites-like coral, all pyritized, poorly preserved, and unidentifiable. There are small lenses of pyrite scattered through the mass and the upper ½ in. is dark in color and largely pyrite (fig. 2, middle part).	0	— 3
9.	Blue-gray, compact, limestone. Composed entirely of part of a colony of the compound, compact coral *Hexagonaria prisma* (Lang and Smith) with the long corralities extending horizontally entirely across the core (fig. 2, basal part and fig. 3). Pyrite has been deposited in porous places and along cracks between or through the corallities. The contact with the unit above is sharp, with small jagged irregularities which cut across and into the internal structures of the corallites without any distortion. The basal contact of the dense coral mass, with the grainy limestone below, drops two inches in the width of the core and along this surface the limestone forms a sharp contact laterally or vertically with any part of the corallites. These contacts of the coral mass are interpreted as solution contacts. The horizontal position of the corallites and the nature of the contacts indicate that the coral colony must have been overturned, probably moved, and was lying on the surface when buried by the detrital material above. The coral is thus a part of the detrital zone but certainly originated in the limestone unit below.	0	— 4
8.	Bluish-gray, fine-grained, compact limestone with some blue streaking and mottling on polished surfaces. Locally, slightly porous with petroliferous staining. In the upper part are poorly preserved, unidentifiable, tubular corals and compound Favosite-like corals.	1	— 9
7.	Gray to bluish-gray, porous, crystalline limestone with much petroliferous staining. Favosite-like, coral structure can be recognized in several of the porous areas and probably most of the porous spaces have originated by the weathering of corals. The basal 9 in. is firmer and more finely crystalline.	3	— 8
6.	Dark-gray to brown conglomerate containing a large pebble or cobble, medium-sized pebbles, small slabby fragments, all dolomite and all set in a matrix of medium to small grains (fig. 1, no. 6, and fig. 4). A longitudinal, polished section of the entire 7 in. of this zone shows at the top a cobble of dark-brown, dense dolomite over 4 in. across and several pebbles, ½ in. to 1 in. across. The lower part of the zone is made up of sub-angular, lenticular, and slabby particles of the dark-brown and gray dolomite. Finally all of these are enclosed in a matrix consisting of medium to fine grains of dark-brown and gray dolmite, oolites, quartz sand grains and much pyrite. The polished surface of the large cobble shows undulating, more or less contorted, discontinuous, alternating bands or lenses of dark-brown dolomite and less distinct, grayish-brown dolomite. The dark-brown color dominates but the undulating pattern is brought out by the floculent streaks of graysh brown. It is one of the types of structure commonly referred to algae and is so regarded by the writer although no positive algal structures have been found. Between the bands, singly or as thin partings, or in pockets, are small round or oblong dolomite grains 0.2 to 0.3 mm. in diameter, some of which appear to have concentric or radiating structure or appear hollow, and apparently are oolites. Most interesting are the cases where a number of these oolite-like bodies occupy a pocket which must have been at one time a depression in the surface of the algal mass made by the thinning and downfolding of the laminae locally. Such pockets have been figured by authors under the name conceptacles and the oolite-like bodies interpreted as spore cases or some other type of reproductive body (Wieland, 1914). The matrix consists of small sub rounded grains of compact gray dolomite; quartz sand grains; oolites; and fine calcareous sediment and pyrite which form the cementing material. The oolites are most distinct at the basal contact of the zone where the cement has been partly removed allowing each oolite to show its distinct form, and the absence of any interlocking crystalline texture. The upper contact of this zone in the core is a sloping, solution contact with a parting about 1 mm. thick of greenish, argillaceous material with quartz sand grains and	0	— 7

		Thickness Ft.	In.
	much pyrite. The stone below the parting across most of the core is the brown algal cobble and on one side of the core a stylolite prong of the gray, fine-grained limestone of the zone above, ¼ in. across and ⅞ in. long, extends down into the dense, brown, algal dolomite of the cobble showing the extent to which interlayer solution has taken place (fig. 1, zone 6).		
5.	Gray to brownish-gray, dense dolomite..... This zone (fig. 5) may be largely of algal origin but is of a different type from the algal mass of zone 6. The lowest one inch is made up of thin laminae which have a broad domal structure ½ in. to 1½ in. across. This grades upward into a part in which the units are ½ in. to ¾ in. across and the laminae are more strongly domed, and this grades back quite abruptly to essentially horizontal laminae. The laminae consist of very thin, at places discontinuous, gray partings alternating with thicker brown units about three times as thick as the gray partings, which indeed appear to be inserted in the denser, brown stone. The upper 1 to 2 in. is light-gray and dark-gray, dense dolomite in alternating, undulating layers ⅛ to ½ in. thick with uneven contacts.	0	4
4.	Light-gray to brownish-gray, compact dolomite..... The core of this zone was sectioned for its full length. The upper 2 to 3 in. is an algal mass composed of brownish-gray, dense dolomite with some irregularly shaped open spaces (figs. 6 and 7). It consists of thicker brown laminae and thin gray partings similar to those in zone 5 above but the mode of growth is quite different. The domed units are quite distinct columns being about ½ in. across and 3 in. long, lying transverse to the vertical of the core. The doming of the laminae is more pronounced. At the base of this algal mass in the core is a ½ in. to 1 in. layer of breccia in which angular fragments of brown algal stone are enclosed in a gray matrix. Farther down through the zone the texture is somewhat irregular and the color mottled as if crushing had taken place, and at the base of the zone much of the width of the core is breccia.	0	11
3.	Brown and brownish-gray, vesicular and porous, irregular-textured, broken dolomite..... This zone consists of angular fragments of dark-brown, dense dolomite in a matrix of smaller fragments of brown dolomite, oolites, and brownish-gray, finer material. It was apparently formed by the crushing of a vesicular rock, possibly an algal mass with openings. At the base of this zone is a smooth rounded, domed surface 2 by 2½ in. and rising ½ in. above the enclosing stone (fig. 8). A vertical section through this domed mass, plus broken laminae on the upper surface, shows fifteen pairs of the characteristic succession of brown, dense layer and brownish-gray parting. The entire ball-like mass is enclosed in oolites.	1	0
2.	Brown, even-textured, oolitic dolomite..... The stone is composed almost entirely of small oolites about 0.5 mm. in diameter. They are dominantly round, a few are oblong. On a polished surface of the stone they are shown imbedded in a dense dark-brown matrix.	3	0
1.	Brown, irregularly-textured, porous dolomite..... Rough-textured dolomite consisting of masses of brown, dense stone, some oolite grains and gray porous matrix. It is somewhat broken or crushed thus resembling the stone of zone 3. This is the base of the core at well-depth 577 ft.	0	2

EXPLANATION OF FIGURES 2-8

2. Upper part, is base of Olentangy shale. Middle part is zone 10, the detrital material on top of Columbus limestone. Basal part is top of coral colony, Hexagonaria.
3. Cross section of corallites of *Hexagonaria prisma* showing diagnostic characteristics. Zone 9, Columbus limestone.
4. (X½) The detrital material at Siluro-Devonian contact, zone 6 entire. The large cobble above may show algal structure.
5. Structure in Raisin River dolomite, zone 5, that may be of algal origin.
6. Structure in Raisin River dolomite, zone 4, that may be of algal origin.
7. Same specimen as in No. 6, sectioned at right angle.
8. Specimen from Raisin River dolomite, zone 3, showing laminated domal mass enclosed in oolitic and detrital material.

Sections and photographs by Richard Bowman.


2
4 X ½
5
7
3
6
8

GEOLOGIC AGE OF THE CALCAREOUS ROCK STRATA

The following is a geologic column of the rock units present along a north-south belt through central Ohio. To this the reader may refer for the stratigraphic position of the unit-names used in the following discussion.

Upper Devonian..... Ohio Shale
Olentangy shale
Erian..... Prout limestone, Plum Brook shale —not known South of Erie Co.
Delaware limestone—not known south of Franklin Co.
Ulsterian..... Columbus limestone—not known south of Pickaway Co.
Detroit River dolomite—not known south of Sandusky Co.
Hillsboro sandstone—locally at Sil.-Dev. contact.
Bass Islands..... Raisin River dolomite
Put-in-Bay dolomite
Tymochtee shaly dolomite
Greenfield dolomite
Niagaran..... Peebles dolomite, Lilley dolomite, Bisher dolomite —in Highland and Adams Cos.

In the foregoing section of the calcareous strata below the Upper Devonian shale there are two detrital units; zone 10 and 9 at the top just below the shale where one might expect a stratigraphic break, and zone 6 near the center of the calcareous section where a stratigraphic break would be much less probable.

Zones 8 and 7 above the lower detrital zone consist of gray to bluish-gray, compact to somewhat porous, finely-crystalline dolomitic limestone. Very poorly preserved, unidentifiable corals, including slender tubular types, a small horn coral and compound Favosites-like forms exist in zones 7, 8, and 10. These corals suggest a Devonian age but the one decisive fossil of the entire calcareous section is the colony of the compound, compact coral *Hexagonaria prisma* (Lang and Smith) which forms zone 9 (fig. 1, no. 9; fig. 2, basal part; and fig. 3). The characteristics of the genus are very definite and our specimen is notably well preserved showing on polished sections all the essential internal structures. The genus *Hexagonaria* is known only from the Devonian and *H. prisma* is a species present in the Columbus limestone of central Ohio.

On the basis of this *Hexagonaria prisma* colony, supported by the unidentifiable corals of zones 7 and 8, we must decide that the rock unit which lies disconformably below the Upper Devonian shale is the Columbus limestone down to the lower detrital zone. This includes zones 7 to 10 with a total thickness of 6 ft.

In the Columbus region of central Ohio *Hexagonaria prisma* is known only in zone H at the top of the Columbus limestone, which formation has there a total thickness of about 100 ft. Further, it is believed, on fossil evidence that this upper part of the Columbus continues northward to the Sandusky region but that the lower part of the Columbus of central Ohio is overlapped northward. The presence of *Hexagonaria prisma* in this core suggests that it is the highest part of the Columbus that is represented here. Since the Columbus is only 6 ft. thick in the core and the specimen of *Hexagonaria* is at the top, this interpretation would require that the Columbus sea did not reach this locality until late in Columbus time. It seems improbable that the marine Columbus limestone overlaps eastward away from the Cincinnati anticline. As noted above (zone 9) there is evidence that the Hexagonaria mass is part of the detrital unit resting on the Columbus and therefore may have originated at a higher stratigraphic level and a later time than the limestone layer on which it finally came to rest. However, it is very improbable that a piece of limestone released from its parent ledge in a region of

denudation could remain on or in the mantle rock during the time required for the lowering of the region some 50 to 75 ft. and then become buried beneath the sediments of a new cycle of deposition without complete disintegration or decomposition.

It is noted in the description of the geologic section that the matrix of the lower detrital zone (no. 6) contains quartz grains. In the basal 3 to 4 in. these quartz grains may constitute 10 to 15 percent of the whole, decreasing rapidly upward. When freed from the dolomite by treatment with acid most of the grains are clear rock-crystal quartz between 0.25 and 0.5 mm. diameter, well rounded and pitted or frosted with minute pits. Some of the grains show secondary enlargement by growth of hexagonal pointed ends and high-luster prism faces. The characteristics of these sand grains are identical with those found at the Siluro-Devonian systemic contact from north to south across Ohio; the Sylvania sandstone of Lucas County, the basal zone A of the Columbus limestone of central Ohio, and the Hillsboro sandstone of Highland County in southern Ohio. At all places, this sand or sandy material rests disconformably on the highest Silurian rock unit present at that locality when the sand was deposited. This is commonly on one of the four members of the Bass Islands group but in Highland County where the erosion had been greater, the Hillsboro sandstone at places rests on a still lower unit, the Niagaran dolomite. The sand unit is overlain by the first rock unit deposited at that place by the encroaching Devonian sea. In northern Ohio this is the Detroit River dolomite, the lowest Devonian rock unit in Ohio; in central Ohio the Detroit River is missing and the sand is found in the basal layers of the next overlying unit, the Columbus; and in southern Ohio where the Columbus and Delaware limestones are also absent the Upper Devonian shale rests on the sandstone or in its absence, on Niagaran dolomite.

On the basis of the characteristics of the quartz sand in this lower detrital zone and its stratigraphical position below the Columbus limestone in this part of Ohio, this zone 6 must mark the Siluro-Devonian contact horizon.

Zones 1 to 5 below the lower detrital unit consist of gray through brownish-gray to brown, compact to dense, and in part crushed or fractured dolomite. Oolites are present, and in zone 2 they constitute most of the rock material. No animal fossils were found in the 6 ft. of this lower division of the calcareous section but structures which are noted in the foregoing pages as probably fossil algae are present in zones 3, 4, 5, and 6. So far as the writer knows fossil algae have not been previously reported from any Silurian rock unit of Ohio and there are very few references to algae in Silurian or Devonian strata anywhere. Therefore these probable algae may have very little value for correlation purposes even when more thoroughly determined. The writer has long suspected that certain spheroidal and domal, laminated forms in the Bass Islands group might have had an algal origin but has found no conclusive evidence for this interpretation. One such rudely spherical, laminated form from the Greenfield dolomite of the Bass Islands was studied by John W. Wells with a negative conclusion as to having an algal origin (Wells, 1942).

The lithology of this lower unit accords well with that of the upper Bass Islands dolomite and especially with that of the Raisin River formation, the highest unit of the Bass Islands, and of the Silurian system in Ohio. The Raisin River is also suggested by the presence of oolitic dolomite so notably developed in zone 2 of the foregoing section and present also in zones 1, 3, and 6. Oolites are very characteristic of the Raisin River dolomite of Monroe County of southeastern Michigan, the type locality for this member (Grabau and Sherzer, 1910), and they have been seen at a few places in the Raisin River member in Lucas County, Ohio. There are many references in the literature noting the association of oolites and fossil algae in the same formation. Probably both require or are favored by a high percentage of calcium carbonate in the sea water whether they have an organic or a physico-chemical origin.

The Raisin River member has not been positively identified in central Ohio by its type fossils as known in southeastern Michigan and northwestern Ohio. However, the strata directly underlying the Columbus limestone in western Delaware and Franklin counties are certainly Upper Bass Islands (Put-in-Bay or Raisin River) and there, as in this Chillicothe test-core, the lithology indicated Raisin River rather than Put-in-Bay. In neither case does the lithology suggest the Greenfield or the Tymochtee, the two lowest members of the Bass Islands group.

On the bases of 1. stratigraphic position directly below the Columbus limestone; 2. the presence in the detrital zone 6 of the distinctive quartz sand that characterizes the Siluro-Devonian contact widely over Ohio; 3. the similarity of lithology; 4. the presence of oolitic dolomite; we assign zones 1 to 6 of the foregoing section to the Raisin River dolomite here penetrated only 6 ft.

The revision here presented does not effect the areal distribution of the rock formations concerned. There is therefore no change on the areal geologic map. It does however make somewhat more exact our knowledge of the actual distribution of certain formations under cover. Along a north to south course thru central Ohio the Upper Devonian shale (Olentangy and Ohio) overlaps the Prout and Plum Creek units south of Erie County so that in central Ohio the Olentangy rests on the Delaware limestone. Continuing southward it overlaps successively the Delaware and the Columbus and south of Pickaway County, rests on the Bass Islands or the Niagaran. The presence of 6 ft. of Columbus limestone in the test-core indicated that the north-south course of the west edge of the Devonian limestone under cover probably passes just west of Chillicothe.

South of Fayette County the Upper Bass Islands unit is not represented on the outcrop and the Lower Bass Islands unit has only a patchy distribution thence southward to beyond the Ohio River. On this basis it has been natural to assume that probably the Upper Bass Islands unit was never deposited in southern Ohio. The presence of strata here interpreted as Raisin River dolomite, the highest unit of the Bass Islands group, in the base of the test-core section, 18 mi. east of where the Greenfield passes beneath the upper Devonian shale, suggests that the complete section of the Bass Islands is present under cover to the east and southeast under southeastern Ohio.

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Handbook of Pest Control. *Arnold Mallis.* MacNair-Dorland Co., New York. Second edition, 1954. 1068 pp. $9.25.

The second edition of this comprehensive and important treatise upon the biology, habits, and control of rodents, roaches, termites, bed-bugs, moths, ants, lice, fleas, flies, mosquitoes, bees, wasps, spiders, mites, ticks and other household and industrial pests covers the same field as the first edition. It is greatly enlarged and brought up to-date and includes the results of the major research work performed in this field and cites the latest and most effective control measures for these pests. It is the most technical, complete, comprehensive, accurate and up-to-date book of this nature and is a necessary reference and handbook for the pest control expert working in this field.

It is also suited as a reference text in courses dealing with the study of household insects or the control of industrial insect and rodent pests. The author has performed an excellent piece of work in the selection and compilation of this material.

DWIGHT M. DELONG

CHANGES WITH AGE IN THE PROPORTION OF THE DOMINANTS IN A BEECH-MAPLE FOREST IN CENTRAL OHIO[1]

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In considering the concepts of plant succession and the community changes that it implies, the primary principle that may be distilled is this: whatever the compositional change wrought in any given community by successional phenomena, irrespective of direction, degree, or duration, the mechanism is that of individual replacement. As a given plant dies, if the space it once occupied is assumed by another individual of another species, a compositional change has been wrought in the community pattern. When the replacements have occurred in such fashion and such number as to alter grossly the appearance of the vegetation of an area, succession is said to have occurred, and one distinct community type has been replaced by another, assuming conditions which preclude drastic alteration of the macroclimate of the region.

It would be well here to clarify the difference between the how and the why of such change in time. The mechanism of replacement is proposed here to answer the how and when. The why involves all of the effects of the varying environmental factors, micro- and macro-, reflected in the rates of processes of the individual, as determined by inherent genetic limitations, operative from the propagule to the senescent stage. It is also recognized, however, that the mechanism of individual replacement may result in no discernible change in a community's appearance, structure or composition, and so it becomes the instrument of maintenance, rather than succession. The distinction is drawn, then in whether the replacement results in like (maintenance) or dissimilar (succession) populations.

Thus when the state of self-replacement has been reached by a community, it remains in a relatively perfect to imperfect state of equilibrium with its environment. And though the community fails to substantially change through time, within such a community the meachanism of individual replacement continues, and striving to answer the question "why? " remains as staggering a task as answering the "why? " concerned with succession.

Of the various associations composing the vegetational mosaic of the Ohio till plains, the climax mesophytic association is that dominated by American beech (*Fagus grandifolia* Ehrh.) and sugar maple (*Acer saccharum* Marsh). This community has given its name to the forest region delimited largely by the extent of Wisconsin glaciation.

Although considered one of the regional climaxes, the beech-maple community exists areally side by side with developmental communities of the region, such co-existence being brought about to a great extent by the slight topographic irregularities characteristic of the till plain. This climax community occupies well aerated portions of the region, the swamp forest developmental stages occurring in the poorly drained depressions, flat uplands and along flood plains, and the oak-hickory type on the excessively drained rises and morainal ridge tops (Braun, 1950).

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[1]Personal acknowledgements are made to John N. Wolfe. Publication No. 569, Department of Botany and Plant Pathology, The Ohio State University.

THE PROBLEM

The beech-maple community because of its mesophytic position in the developmental relationships of the regional vegetation, and because of its large areal extent originally, has been the subject of numerous investigations. Three of these in the writer's opinion appear to be outstanding. Esten's (1932) because it is the first attempt at quantitative investigation into all portions of the community, Cain's (1935) because it remains even until today the most complete quantitative investigation into the community structure *per se*, Williams' (1936) because of its unique bio-approach to the community.

One of the more interesting phenomena mentioned by all three of these investigators is the numerical superiority of beech over maple in the canopy with the situation reversed in the reproduction.

Esten (1932) in her summary, says, "It was evident in the entire area and in the large quadrats where trees above two inches in diameter were considered that beech was higher in both coverage and frequency than maple, although maple was slightly higher in density. . . . In the four meter quadrats, where seedlings and saplings under two inches in diameter were counted, a great difference was noted in the reproduction of the two species. In 1931 there were 399 individuals of *Acer saccharum* as contrasted to twenty-eight of *Fagus grandifolia*. In 1932 a count was made of the beech and maple seedlings and saplings in the same area, and the maples showed an even greater gain in the reproductive layer over the beeches. At this time there were 1433 maples and seventy-three beeches, most of these being seedlings."

Cain (1935) recording a conversation with an old resident from the Warren's Woods area, remarks: "Fifty years ago, as now, the woods were dominantly beech, but not so much so. Mr. King also emphasized the heavy maple reproduction which now attracts so much attention. He remembers this as characteristic since his first acquaintance with the woods."

Williams' (1936) writing of the reproduction within a beech-maple area where trees 3.5 in. and over did show an almost 2:1 ratio in favor of beech, says: "The seeding of both beech and sugar maple is periodically abundant, but beech seedlings do not survive as well as those of sugar maple in the early stages of their development. In one area approximately 25 ft. sq., 12 beech trees of from 2 to 4 season's growth were counted, while the number of sugar maples of the same ages in the same area was estimated to be in the neighborhood of 3,000, a proportion of 1 beech to 250 sugar maples. Yet the high mortality of young sugar maple saplings later seems to more than make up for this difference in the early years of development."

Braun (1950), in her summary of the association type, states that "beech is usually the most abundant canopy tree, while sugar maple dominates in the understory."

An interesting facet of this consideration involves speculation as to a possible increase in the importance of maple in the canopy in view of its great numerical superiority in youthful stages. As indicated from the quotation above, Williams (1936) is of the viewpoint that progressive changes occur from the young trees to the mature, and that the dominance of beech will be maintained indefinitely under present day conditions. He cites further evidence from conversation with a resident in the area of his investigation, in which the resident, Mr. Percy Parker, points out that areas now clear of understory trees were densely crowded with sugar maple saplings when he was a boy. Esten (1932) indicates that although no definite conclusions may be drawn, evidence so far indicates that maple may be succeeding beech. Cain (1935) indicates that "it does not seem to the writer that we are yet justified in saying that maple is generally tending to increase in importance over beech in these western areas now dominated by beech, but this

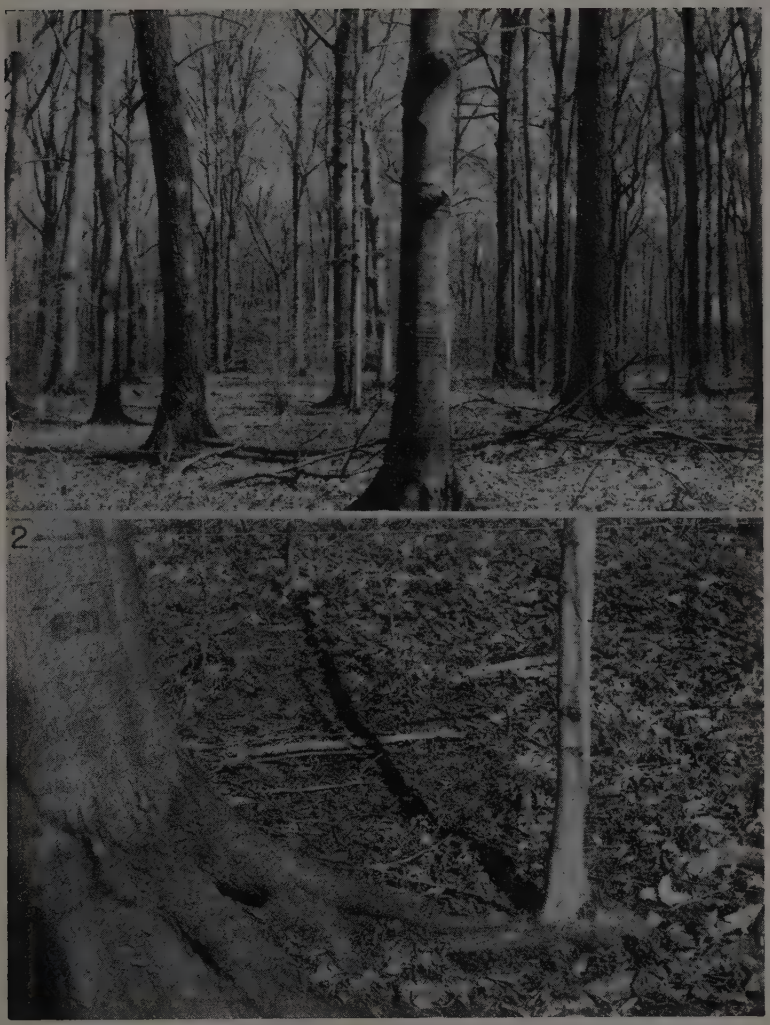

FIGURE 1. Overall View of the Problem Area Indicating Dominance of Beech in the Canopy Stems.
FIGURE 2. Close View of Canopy Beech and Root Sprouts.

successional tendency is strongly indicated for several places known to the writer in Indiana and Michigan."

It seems unwise to postulate an increasing role of importance for maple in the canopy, in view of the testimony offered by Williams and Cain, and in addition, the lack of known communities within the boundaries of what has been delimited as a Beech-Maple region, that show numerical superiority of sugar maple to beech in the canopy layers. Indeed, only in the northern transition zone between the Deciduous Forest and Hemlock-Hardwood regions, are there communities where sugar maple is numerically dominant; these are transitional in nature, reflecting the varying ranges of environmental control in such areas.

As suggested earlier, then, a two-fold problem concerning this change in dominance remains: When does beech attain ascendancy? And why? It is with the former question that this brief study is concerned.

LOCATION OF STUDY AREA

In order to gain some awareness of the nature of the change occurring in the relative proportions of beech and maple as they pass through the various stages of their communal existence in the development from seedling to dominant, this investigation was undertaken. A "typical" area of Beech-Maple forest was selected to obtain information on the proportions of beech and maple at various age and height levels.

This area, which DeSelm (1952) has described in greater detail, lies "at the western edge of a level to gently undulating Late Wisconsin till plain, between Black Lick Creek and South Fork of the Licking River. It is in northwestern Etna Township, Sec. 3, T 16 N, R 20 N, Licking County, as noted on the Thurston, Ohio, U.S.G.S. quadrangle.

"The elevation varies from about 1080 ft. along a slight ground swell at the western edge of the forest, to 1070 ft. along an intermittent, south-flowing stream which bisects the forest. The terrain thus slopes gently east and south.

"Two soil types form a mosaic in the . . . area, . . . the Marengo silty clay loam and the Bennington silt loam, both derived from glacial drift largely composed of sandstones and shales. . . . . The former developes on flat upland areas having poor internal drainage and abundant organic matter. Internal drainage of Bennington is better than that of Marengo although accumulation of organic matter is less. It occurs on the undulating uplands. . .

"Beech (*Fagus grandifolia*), constituting over half the canopy, dominates the vegetation in the sampling area" (fig. 1).

The counts, reported in the present paper, were made during the prevernal season of 1954.

METHODS AND RESULTS

An area 100 ft. sq. was chosen in which there were 8 beech and 3 maple crowns in the canopy (72.73% beech; 27.27% maple). In all there were 19 trees over 3 in. dbh; 9 beech (47.37%), 4 maple (21.05%), 4 elm (21.05%) and 2 ash (10.53%). One beech was in the immediate understory. One of the four maples was dead, with the bole still standing.

In addition, within the 10,000 sq. ft. area, 10 smaller quadrats, 3 ft. sq., were randomly distributed in order to count the low beech and maple seedlings, one and two years old.

All beeches and maples older than this were counted within the entire area of the large quadrat. For the younger stages, ages were determined by counts of the terminal bud scale scars, for the older ones annual ring counts were used. The distribution of individuals with age is presented in table 1. The counts from the small quadrats have not been converted to an equal area basis, since the percentages would not be effected, and these are used to indicate the trends. It

should be indicated that beech reproduces not only by seed but also by means of sprouts arising from the roots (fig. 2). Such sprouting was not observed to occur on maples. Five of the 8 canopy beech exhibited this sprouting phenomenon, one having 16 sprouts, another 13, another 9, and two had one each. These have been included in the data, and their effect on the counts noted in the table.

Beech does not gain a persistent numerical ascendency until the 40-year group is reached. In the earlier ages, the maple greatly exceeds the beech, save for the anomalous condition in the 2 and 3-year old groups. When root sprouts of beech are eliminated from consideration maple is numerically superior in all age group-

TABLE 1

Proportions of beech and maple under canopy level at various ages in a "typical" Beech-Maple Forest in Central Ohio

					Without Root Sprouts		
Age	No. of Maple	No. of Beech	% Maple	% Beech	No. of Beech	% Maple	% Beech
1	482	96	83.39	16.61	96	83.39	16.61
2	7	10	41.18	58.82	10	41.18	58.82
3	8	10	44.44	55.56	10	44.44	55.56
4	10	7	58.82	41.18	7	58.82	41.18
5	14	9	60.87	39.13	9	60.87	39.13
6	21	10	67.74	32.26	10	67.74	32.26
7	28	11	71.79	28.21	11	71.79	28.21
8	24	11	68.57	31.43	10	70.59	29.41
9	23	7	76.67	23.33	7	76.67	23.33
10	31	6	83.78	16.22	6	83.78	16.22
11	25	6	80.65	19.35	5	83.33	16.67
12	27	9	75.00	25.00	6	81.92	18.18
13	27	8	77.14	77.14	7	79.41	20.59
14	18	9	66.67	33.33	8	69.23	30.77
15	20	8	71.43	28.57	7	74.07	25.93
16	12	7	63.16	36.84	6	66.67	33.33
17	13	9	59.09	40.91	6	68.42	31.58
18	12	7	63.16	36.84	3	80.00	20.00
19	14	6	70.00	30.00	4	77.78	22.22
20	10	7	58.85	41.18	3	76.92	23.08
21	9	5	64.29	35.71	4	69.23	30.77
22	7	5	58.33	41.67	4	63.64	35.36
23	9	2	81.82	18.18	1	90.00	10.00
24	10	3	76.92	23.08	2	83.33	16.67
25	2	2	50.00	50.00	1	66.67	33.33
26	4	1	80.00	20.00	0	100.00	00.00
27	3	0	100.00	00.00	0	100.00	00.00
28	2	2	50.00	50.00	0	100.00	00.00
29	3	2	60.00	40.00	0	100.00	00.00
30–40	8	5	61.54	38.46	1	88.89	11.11
40–70	2	4	33.35	66.67	0	100.00	00.00

ings (table 1). The average heights of the individuals in the age groups are indicated in table 2. Beech is consistently taller than maple in each group, indicating a faster vertical growth rate. The oldest tree of this grouping, however, is a 63 year old maple, 14.3 ft. tall, while the oldest beech, 50 years, is 48.8 ft. tall.

Data are presented in table 3, grouping the two species according to height classes. In the lower height classes maple is again numerically superior but proportionally decreasing with increasing height. After 3.5 ft., however, numbers of beech exceed those of maple and continue to do so with the successively taller groups. Without considering root sprouts beech still attains the majority, but not to as great an extent, and is absent from the tallest groupings (> 102 in.).

CONCLUSIONS

Data gathered in this study indicate that the transference of numerical dominance from maple to beech occurs in the age group between 40–70 years. In height grouping the changeover occurs at the 3.5 ft. level and beech superiority becomes stronger with increasing height. It is unfortunate that the critical age group is one in which the sample size is small. Data from other investigators also show this absence of numbers in the critical group (table 4).

TABLE 2

Average height of beech and maple for each of the various age groups

Age	Average Height (Inches) Maple	Beech
1	3.5	5.0
2	5.1	5.4
3	6.1	7.0
4	7.9	8.4
5	9.7	11.4
6	9.8	11.8
7	9.6	15.9
8	10.2	14.8
9	10.3	22.0
10	10.8	26.0
11	11.3	24.2
12	11.5	24.9
13	11.1	25.1
14	14.1	32.9
15	14.7	30.9
16	14.9	43.5
17	15.7	39.8
18	16.4	42.9
19	20.5	37.7
20	24.0	33.7
21	28.0	39.0
22	24.5	52.2
23	26.5	106.3
24	34.1	53.7
25	41.0	85.0
26	27.2	87.0
27	28.7	.....
28	33.5	96.0
29	28.5	69.5
30	35.0*	70.6
31	31.0*	.....
33	32.5	121.0*
35	48.5	67.0
36	48.0*	.....
38	25.0	127.5*
40	.....	204.5*
45	.....	129.5
50	150.0*	585.0*
63	172.0*	.....

*Based on one individual.

It would seem from study of both age and height data, that the most important factor in the maintenance of beech dominance in the canopy is the ability of beech to reproduce by root sprouts. If these are omitted from consideration in both age and height data then maple has clearer dominance in the older and taller understory groups. Consequently root sprout presence not only re-establishes beech in these groups, but is responsible for the majority it shows. Williams

(1936) also indicates the possible importance of root sprouting and this phenomenon alone is responsible for some dense stands of beech in Pennsylvania, according to Illick and Frantz (1928).

This investigation was undertaken to indicate at what age, and in what height levels, the changes in proportion between beech and maple have occurred, resulting in a beech-maple canopy, after having exhibited maple-beech stages in the reproduction. No definite study has been undertaken to indicate why this phenomenon

TABLE 3

Proportions of beech and maple under the canopy, according to height groups.

Height (inches)	No. of Maple	No. of Beech	% Maple	% Beech	No. of Beech	Without Root Sprouts % Maple	%Beech
0–6	540	47	91.99	8.01	47	91.99	8.01
6–12	224	46	82.96	17.04	46	82.96	17.04
12–18	63	22	74.12	25.88	19	76.83	23.17
18–24	34	26	56.67	43.33	25	59.65	40.35
24–30	25	21	54.35	45.65	16	60.98	39.02
30–36	24	17	58.54	41.46	13	64.86	35.14
36–42	17	18	48.57	51.43	14	54.84	45.16
42–48	2	7	22.22	77.78	4	33.33	66.67
48–54	1	8	11.11	88.89	7	12.50	87.50
54–102	0	18	00.00	100.00	10	00.00	100.00
102–	2	9	18.18	81.82	0	100.00	00.00

TABLE 4

Proportions of beech and maple from data of Cain (3) *and Esten* (4). (*Compiled by Cain* (3)).

Cain

Classes	No. Beech	No. Maple	Ratio
Under 1 ft. high	156	3,923	1 : 25
Under 1 in. d.b.h.	230	1,055	1 : 14
1 in. d.b.h.	38	61	1 : 2
2 in. d.b.h.	8	12	1 : 1.5
3 in. d.b.h.	1	3	1 : 3
4–9 in. d.b.h.	11	2	5.5 : 1

Esten

Under 2 in. d.b.h.	224	3.392	1 : 4
2 in.	10	25	1 : 2.3
4 in.	3	12	1 : 4
6 in. or over	24	2	12 : 1

occurs. Speculation as to some factors involved might indicate sporadic light seeding of beech, and the use of beech nuts as forage by many of the small animals inhabiting such a forest of importance in determining the maple dominance in the youthful stages; the faster vertical growth rate of beech, variation with age in the photosynthetic-respiratory ratios, differing frost resistance, and others as determining factors in the subsequent establishment of beech numerical superiority. Of interest from the above data is the temporary majority of beech in the two and three year groups. This may indicate a heavy mortality of one year old

maple seedlings, especially during drought years such as occurred in the region just prior to the present study. If the "why" answer is to be found it may well lie in a study of such extremes, for it is an ecological truism that extremes rather than the means are the important determiners of species limits, both geographical and communal. It has been indicated, that for this area, beech root sprouting has been a deciding factor for beech dominance in late stages; why such sprouting occurs on some beeches and not on others, is unknown to the author.

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The Physical Chemistry of the Silicates. *Wilhelm Eitel.* The University of Chicago Press, Chicago. First English Edition, 1954. xvii+1592 pp. $30.00.

Books of this magnitude are rarely attempted by individual authors today. Dr. Eitel points out in his preface that it represents a third, but first English, edition of a work first presented in 1929, but its accomplishment becomes more amazing in view of Dr. Eitel's limited experience in writing English prior to his arrival in the U. S. from Germany at the close of World War II. When considered in light of personal communications, which this reviewer received from Dr. Eitel soon after he came to America, Dr. Eitel's mastery of English is remarkable.

The overall objective of this book is to interrelate the properties of silicates to igneous petrology as well as several important technologies, including process metallurgy and ceramic engineering. In order to accomplish this purpose, it is necessary to consider a large number of silicate compositions over significant ranges of temperature with respect to a knowledge of phases present, their polymorphic inversions, their ability to fuse or interact with other phases, their ability to form crystalline solutions, etc. Illustrative materials consist of 952 charts and diagrams of equilibria of chemical systems, crystal structure models, and experimental apparatus.

The subject matter is divided into five major topics: (A) The states of the silicates, (B) Fusion and polymorphic equilibria in dry silicate systems, (C) Pneumatogenic and hydratogenic silicates, (D) Solid-state reactions and their ceramic use, and (E) Silicate melts as industrial glasses and slags. Each of these topics is subdivided. There are six indexes: Subjects, minerals and rock species, systematic for the special silicate melt equilibria, alphabetical for silicate and related systems, chemical compounds, and authors. The author index contains more than 4500 names, indicating a topic, division, and a paragraph number (rather than a page number) for each citation.

Dr. Eitel has not attempted a critical evaluation in numerous instances where conflicting interpretations have not been resolved. Nevertheless, he has performed a very useful service in sifting out the important contributions from the vast quantity of almost meaningless details to be found in the literature. Early references have been omitted, and although the book covers results obtained during the past fifty years, a large portion of the cited works are later than 1930. Numerous references to papers which were published in 1952 are cited in spite of the date of August 1952 on the preface.

In a work of this scope, minor errors are expectable. The reviewer noticed a few, particularly in some of the references. The typography and format represent the usual high standards of the publisher. Considering the thickness, the binding seems frail. The price of $30.00 might invoke hesitancy, but for persons actively engaged in research in applied mineralogy or silicate chemistry, this book is unquestionably a worthwhile investment. There is nothing strictly comparable on this subject.

DUNCAN MCCONNELL

SMALL FORAMINIFERA OF THE POTTSVILLE FORMATION IN OHIO

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The Pottsville is the oldest formation of the Pennsylvanian system in Ohio. It contains four marine limestone members which may logically be expected to contain foraminifera. In ascending order these are; the Lowellville or Poverty Run, the Boggs, the Lower Mercer and the Upper Mercer limestones. Although these are spoken of as limestones, their lithologies vary from place to place. Flint, limestone, shale and iron ore may be present, either singly, or in any combination,—or the marine member of the cyclothem may be wanting altogether, due to local erosion or to nondeposition.

Each of the four limestone members was sampled at a number of points along the outcrop belt across the state. Foraminifera were found in 32 samples, in the Poverty Run, Lower Mercer and Upper Mercer limestones. As yet, I have found no microfossils in the Boggs member, which may be because they have not been preserved, or may only be the result of unlucky sampling. Foraminifera occur in all of the lithologies which may be encountered in these marine zones, but seem to be most abundant in the calcareous shales. This greater abundance may be more apparent than real;—the small fossils are more easily recovered from shales than from the harder rocks. There are localities in Scioto and Jackson counties where the Lower Mercer could be described as a "foraminiferal limestone", the hard limestone being composed very largely of the tests of the genus *Ozawainella*.

A fauna of 17 species, grouped under six families of the smaller foraminifera, has been identified. All of these forms are assigned to previously described species. The Poverty Run contained nine species, one of which, *Glomospira* cf. *G. simplex* Harlton, was found only in this member. The Lower Mercer contained 16 species, seven of which were limited to it, so far as this study is concerned. Of the five species in the Upper Mercer, no form was found that was not also present in the Lower Mercer.

A number of workers have studied the Pennsylvanian foraminifera of Texas and the Mid-Continent areas. Like the larger fossils of the Pennsylvanian, the foraminifera seem to have changed slowly and had wide geographic distribution. All of the species found in Ohio have been found, also, in the Southwest. Ten are common to both the Ohio Pottsville and to the Pennsylvanian strata of several epochs in Texas. Ten species reported from a lower Des Moinesian limestone in Indiana are found in the Pottsville in Ohio. Fourteen species found in Ohio have also been reported from Pennyslvanian rocks in Oklahoma.

The present study, then, gives further evidence that Pennsylvanian small foraminifera are long-ranging in both time and space, and in the present state of our knowledge cannot be used for close correlation of strata.

COLLECTING LOCALITIES

1. Mahoning County, Grindstone Run.
2. Mahoning County, Berlin Township, Little Mill Creek at Route 224.
3. Holmes County, Richland Township, Section 13, N.E. Quarter, at junction of road and lane which comes in from east.
4. Holmes-Coshocton County Line Road between Section 23, Richland Twp. Holmes County and Section 3, Tiverton Twp. Coshocton County.
5. Muskingum County, Falls Township, gully two miles northwest of Dillon.
6. Muskingum County, Hopewell Township, Poverty Run.

The Ohio Journal of Science 55(2): 81, March, 1955.

7. Muskingum County, Hopewell Township, Section 18, N.W. Quarter, at turn in the road.
8. Perry-Muskingum County Line, Limestone Hollow.
9. Perry County, Somerset Railroad cut.
10. Perry County, Reading Township, Section 22, two miles south of Somerset.
11. Hocking County, Falls Gore Township, Hocking Valley Brick Company clay pit.
12. Vinton County, Elk Township, Section 32, N.E. Quarter.
13. Jackson County, Coal Township, Section 10, Old Grace Mine.
14. Scioto County, Vernon Township, Section 24, S.W. Quarter, along the abandoned road south of Lyra.

TABLE 1

Distribution of Species

	Localities													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hyperammina bulbosa Cushman and Waters												×		×
Spirillina concavaconvexa Galloway and Rynicker	×		×	×		×	×	×						
Ammovertella inversa (Shellwien)			×			×			×			×		
Ammovertella cf. *A. latimerensis* Galloway and Harlton			×			×			×			×	×	
Ammodiscus semiconstrictus var. *regularis* Waters					×	×		×				×	×	
Clomospira cf. *G. simplex* Harlton						×								
Tolypammina confusa (Galloway and Harlton)												×		
Endothyra excentralis Cooper	×					×			×	×				
Endothyra ovata Waters	×							×				×		
Endothyra rothrocki Harlton								×	×					
Endothyranella minuta Waters	×						×	×	×		×	×		
Endothyranella sobrina (Plummer)	×	×				×	×	×				×		
Tetrataxis concava Galloway and Rynicker						×			×		×		×	
Tetratasis lata Spandel	×					×			×		×			
Reophax asper Cushman and Waters												×		
Ozawainella ciscoensis (Harlton)			×		×	×						×	×	
Ozawainella radiata (Brady)						×						×	×	

SYSTEMATIC PALEONTOLOGY

Order FORAMINIFERA d'Orbigny, 1826
Family ASTRORHIZIDAE Brady, 1881
Subfamily HYPERAMMININAE Cushman, 1910
Genus HYPERAMMINA Brady, 1878

Hyperammina bulbosa Cushman and Waters

Figures 1–3

Hyperammina bulbosa Cushman and Waters, 1927, Cont. Cushman Lab. Foram. Res., vol. 3, pt. 2, No. 4, p. 109, pl. 22, Fig. 7.

Test free, elongate, consisting of a swollen proloculum and a long, straight second chamber with a number of slight, but noticeable, constrictions at regular intervals. The tube, however, is not divided into chambers. Aperture the open end of the tube. Shell wall very finely arenaceous with a large proportion of cement.

Average diameter of the tube approximately 0.10 mm. The length is difficult to determine because all of the specimens are broken, the pieces averaging between 0.50 mm. and 1.0 mm.

Lower Mercer limestone, Localities 12 and 14. Very abundant.

Family SPIRILLINIDAE Reuss, 1861
Subfamily SPIRILLININAE Brady, 1884
Genus SPIRILLINA Ehrenberg, 1843

Spirillina concavaconvexa Galloway and Rynicker
Figures 4–6

Spirillina concavaconvexa Galloway and Rynicker, 1930, Oklahoma Geol. Survey Circ. 21, p. 7, pl. 1, Figs. 2 a–c.

Test apparently free, minute, a single tube coiled planispirally; one side of the coil convex, the other slightly concave; coil covered with a white calcite deposit which is ornamented on the convex side by fine, radial grooves; coils slightly embracing; aperture crescentic.

Diameter of coil, 0.13 mm.; thickness of last whorl, 0.04 mm.

Poverty Run limestone, Locality 6. Rare. Lower Mercer limestone, Localities 1, 4, 6, 7 and 8. Very abundant. Upper Mercer limestone, Locality 3. Common.

Genus AMMOVERTELLA Cushman, 1928

Ammovertella inversa (Schellwien)
Figures 7–8

Test attached by the whole of one side; a long tube, closely coiling at first, then wandering off irregularly, enlarging very gradually. Schellwien describes the wall as siliceous. Galloway and Rynicker consider it to be calcareous. Some of our specimens show the characteristic noted by the latter authors of the shell substance appearing to spread out on the substratum beyond the wall proper. Surface smooth. Aperture terminal, semicircular.

Diameter of tube approximately 0.1 mm.

Poverty Run limestone, Locality 6. Very abundant. Lower Mercer limestone, Localities 6, 9 and 12. Very abundant. Upper Mercer limestone, Locality 3. Very abundant.

Remarks. There is some disagreement as to the nature and relationship of this form. Cushman, (Cont. Cushman Lab. Foram. Res. vol. 4, pt. 2, pp. 45–49) recognized several species having the same general characteristics but differing chiefly in the pattern of coiling. Galloway (Oklahoma Geol. Surv. Circular 21, p. 10) on the other hand, states that "*Ammovertella* is probably not a foraminifer at all, but a worm. The pattern made by the coiling . . . is probably a distinction not valid for species and surely not for genera."

The opinion of Helen Jean Plummer (University of Texas Bull. 3019, pt. 2, p. 44) was, "That these are true Foraminifera is shown, not only by the structure of the test in thin sections, but also by the occurrence of both microspheric and megalospheric forms . . . . . To place all of these forms together is to overlook much of the data that should be used in the study of these primitive, but very useful foraminifera."

Warthin (Oklahoma Geol. Survey Bull. 53, p. 13) would lump all of the following under the name *Ammovertella inversa* (Schellwien); *Psammophis inversus* Schellwien, *P. inclusus* Cushman and Waters, *Ammovertella inversus* Cushman, *Calcitornella elongata* Cushman and Waters. *C. heathi* Cushman and Waters, *Calcivertella adherens* Cushman and Waters, *Ammovertella undulata* Galloway and Harlton, *A. latimerensis* Galloway and Harlton, and *A. adherens* Galloway and Rynicker. Warthin says, "this species is here interpreted to include all the irregularly coiled, embracing, attached forms with probably hyaline walls, found in this part of the column. The shape of each individual is determined chiefly by the proportions of the object to which it adheres. There is so much variation that, if so inclined, one could make a new species for almost every specimen."

The present writer concurs with this opinion.

Ammovertella sp. cf. **A. Latimerensis** Galloway and Harlton
Figure 9

Ammovertella latimerensis Galloway and Harlton, 1928, Journ. Paleontology vol. 2, p. 342, pl. 45, figs. 3, 4.

If members of this genus are to be assigned specific names on the basis of the manner of their coiling, then certain of our specimens resemble **A. latimerensis** since, after forming a planispiral coil, the tube is bent back and forth sharply upon itself.

Lower Mercer limestone, Localities 6, 9, 12 and 13. Upper Mercer limestone, Locality 3. Very abundant.

Family AMMODISCIDAE Rhumbler, 1895

Genus AMMODISCUS Reuss, 1861

Ammodiscus semiconstrictus var. **regularis** Waters

Figures 10–11

Ammodiscus semiconstrictus var. *regularis* Waters, 1928, Journ. Paleontology vol. 1, p. 132, pl. 22, fig. 2.

Test consisting of a proloculum and a long, undivided second chamber coiled in a nearly planispiral disc; aperture the open end of the tube; wall arenaceous.

Diameter of the test of the figured specimen, 0.27 mm.

Poverty Run limestone, Localities 5 and 6. Very abundant. Lower Mercer limestone, Localities 8, 12 and 13. Very abundant.

EXPLANATION OF FIGURES IN PLATE I

FIGURES 1–3. *Hyperammina bulbosa* Cushman and Waters
1, 2. Initial end, showing typically enlarged proloculum.
3. Fragment of tube, broken at both ends.
O. S. U. M. 19907, Lower Mercer Limestone, Loc. 12.

FIGURES 4–6. *Spirillina concavaconvexa* Galloway and Rynicker
4. Lateral view, showing radial markings.
5. Opposite, or concave side.
6. Apertural view.
O. S. U. M. 19908, Shale over Lower Mercer Limestone, Loc. 9.

FIGURES 7–8. *Ammovertella inversa* (Schellwien)
7. Partially exfoliated specimen in matrix.
8. Another specimen, showing initial coil and variation in later coiling.
O. S. U. M. 19909, Upper Mercer limestone, Loc. 3.

FIGURE 9. *Ammovertella* cf. *A. latimerensis* Galloway and Harlton. Showing tube coiled back sharply upon itself.
O. S. U. M. 19911, Shale under Lower Mercer Limestone, Loc. 8.

FIGURES 10–11. *Ammodiscus semiconstrictus* var. *regularis* Waters. Lateral and apertural views.
O. S. U. M. 19912, Shale under Lower Mercer Limestone, Loc. 12.

FIGURE 12. *Glomospira* cf. *G. simplex* Harlton.
O. S. U. M. 19913, Poverty Run limestone, Loc. 6.

FIGURES 13–14. *Tolypammina confusa* (Galloway and Harlton)
Opposite views of the same individual adhering to a brachiopod spine.
O. S. U. M. 19914, Lower Mercer limestone, Loc. 4.

FIGURES 15–18. *Endothyra excentralis* Cooper
15, 16. Lateral and apertural views of an individual in which the right side is involute and the left, umbilicate.
O. S. U. M. 19915, Shale under Lower Mercer limestone, Loc. 8. 17, 18. Apertural and lateral views of an individual in which the left side is involute and the right, umbilicate.
O. S. U. M. 19916, Lower Mercer limestone, Loc. 1.

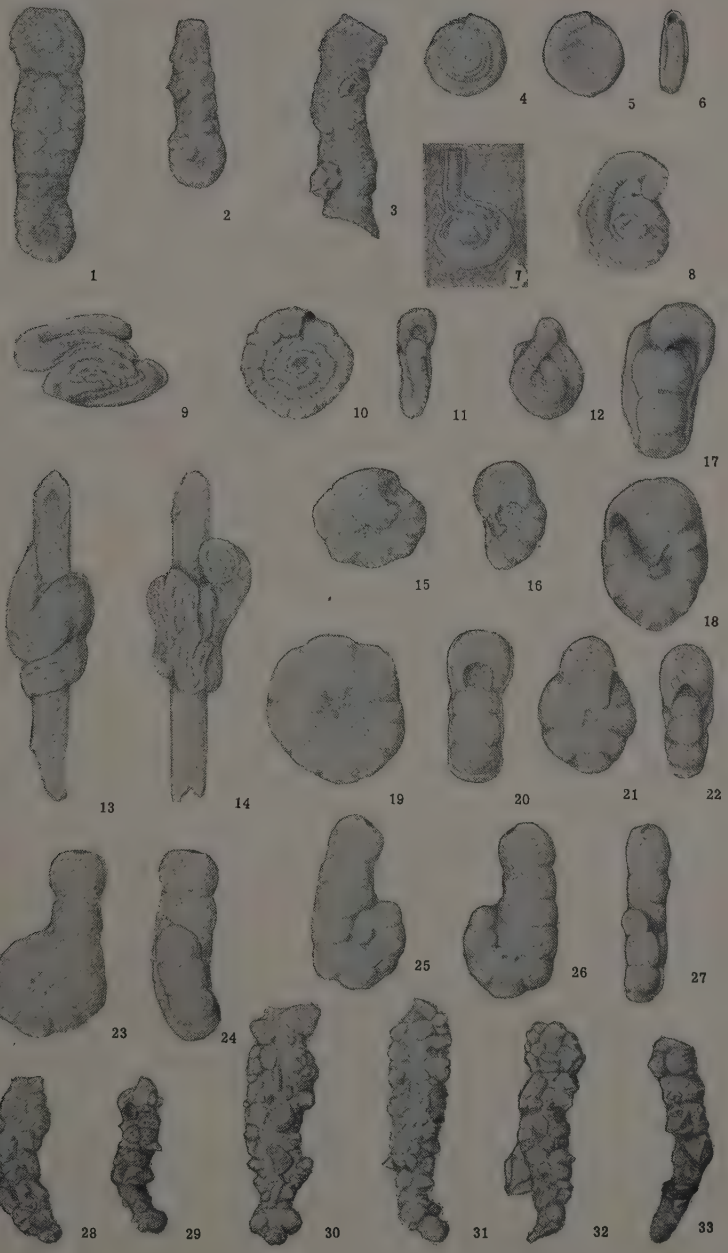
FIGURES 21–22. *Endothyra ovata* Waters
Lateral and apertural views showing rapid increase in size of chambers, and symmetry of coil.
O. S. U. M. 19917, Lower Mercer limestone, Loc. 12.

FIGURES 19–20. *Endothyra rothrocki* Harlton
Lateral and apertural views showing gradual increase in size of chambers, and symmetry of coil.
O. S. U. M. 19918, Shale under Lower Mercer limestone, Loc. 9.

FIGURES 23–24. *Endothyranella sobrina* (Plummer)
Lateral and peripheral views of a typical individual.
O. S. U. M. 19919, Shale over Lower Mercer limestone, Loc. 12.

FIGURES 25–27. *Endothyranella minuta* (Waters)
25. Lateral view showing about two whorls.
26. Opposite side, showing one whorl.
27. Peripheral view.
O. S. U. M. 19920, Shale over Lower Mercer limestone, Loc. 12.

FIGURES 28–33. *Reophax asper* Cushman and Waters
Showing variation in size and materials of test.
O. S. U. M. 19921, Lower Mercer limestone, Loc. 12.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Genus GLOMOSPIRA Rzehak, 1888

Glomospira cf. **G. simplex** Harlton
Figure 12

Glomospira simplex, Harlton, 1928, Journ. Paleontology vol. 1, p. 305, pl. 52, figs. 2 a–c.

Test free, nearly spherical, consisting of a proloculum and a long, tubular second chamber, irregularly coiled and wound around itself; wall arenaceous, nearly smooth, with much cement.

Diameter of test 0.18 mm.; diameter of tube, 0.05 mm.

Poverty Run limestone, Locality 6. Rare.

Genus TOLYPAMMINA Rhumbler, 1895

Tolypammina confusa (Galloway and Harlton)
Figures 13–14

Ammovertella? confusa Galloway and Harlton, 1928, Journ. Paleontology vol. 2, p. 344, pl. 44, fig. 5.
Tolypammina confusa Galloway and Rynicker, 1930, Oklahoma Geol. Survey Circ. 21, p. 11, pl. 1, fig. 14.

A long tube, coiled in an irregular, confused mass, attached usually to brachiopod spines; wall very finely arenaceous; surface nearly smooth. All of our specimens are broken and neither the proloculum nor the aperture is shown.

Diameter of tube, 0.1 mm. or slightly less.

Lower Mercer limestone, Locality 12. Rare to common.

Family ENDOTHYRIDAE Rhumbler, 1895
Subfamily ENDOTHYRINAE Brady, 1884
Genus ENDOTHYRA Phillips, 1846
Endothyra excentralis Cooper
Figures 15–18

Endothyra excentralis Cooper, 1947, Jour. Paleontology vol. 21, p. 88, pl. 20, figs. 19–23.

Test small, free, an asymmetrical, nautiloid coil, about eight chambers in the last volution; chambers inflated, especially the last; one side involute, the other umbilicate; aperture crescentic extending from the center of the margin down the umbilicate side.

Diameter, average, 0.32 mm.

Remarks.—Our specimens average smaller than the type, whose diameter is given as 0.48 mm. In describing the species, Cooper speaks only of forms having the right side involute and the left side umbilicate. Among our specimens there are also individuals which are the mirror image of these, the left side being involute and the right side umbilicate.

Poverty Run limestone, Locality 6. Rare. Lower Mercer limestone, Localities 1, 9 and 10. Rare.

Endothyra ovata Waters
Figures 21–22

Endothyra ovata Waters, 1928, Journ. Paleontology vol. 1, p. 274, pl.42, fig. 6.

Test free, almost planispiral, partially involute, chambers rounded, increasing rapidly in size, about seven or eight in final whorl; aperture arched, at the base of the septal face.

Diameter of figured specimen, 0.33 mm.

Lower Mercer limestone, Localities 1, 8 and 12. Very abundant.

Endothyra rothrocki Harlton
Figures 19–20

Endothyra rothrocki Harlton, 1928, Journ. Paleontology vol. 1, p. 306, pl. 52, fig. 3.

Test free, planispiral, nearly bilaterally symmetrical, umbilicate; margin rounded, lobate; nine chambers in final whorl, increasing very gradually in size; aperture a low crescent at the base of the septal face.

Diameter, 0.35 mm.

Lower Mercer limestone, Localities 8 and 9. Rare.

Genus ENDOTHYRANELLA Galloway and Harlton, 1930

Endothyranella sobrina (Plummer)
Figures 23–24

Endothyranella armstrongi subsp. *sobrina* Plummer, 1944, Texas Univ. Bull. 4401, p. 242, pl. 16, figs. 12–17.

Early portion of test coiled like *Endothyra*, later portion a series of chambers set in a row, tangent to the coil; chambers inflated, increasing in size very gradually; about nine chambers in the last whorl of the coil, three to seven rectilinear chambers; early portion of the coil somewhat obscured by secondary calcite deposits.

Average diameter of coil, 0.27 mm., average length, 0.49 mm.

Poverty Run limestone, Locality 6; Lower Mercer limestone, Localities 1, 2, 6, 7, 8 and 12; Upper Mercer limestone, Locality 3. Very abundant.

Endothyranella minuta (Waters)
Figures 25–27

Endothyranella minuta Galloway and Rynicker, 1930, Oklahoma Geol. Survey Circ. 21, p. 14, pl. 2, figs. 5 a–c, 6 a–c.

Test small, early portion coiled, later portion a series of three or four rectilinear chambers. The plane of coiling diverges from the plane of the rectilinear portion so that two whorls are visible on one side but only one on the other Aperture round, terminal

Diameter of coil, 0.25 mm ; total length, 0.46 mm

Lower Mercer limestone, Localities 1, 7, 8, 9, 11 and 12 Very abundant.

Subfamily TETRATAXINAE Galloway, 1933
Genus TETRATAXIS Ehrenberg, 1843
Tetrataxis concava Galloway and Rynicker
Figures 34–36

Tetrataxis concava Galloway and Rynicker, 1930, Oklahoma Geol. Survey Circ. 21, p. 18, pl. 3, figs. 6 a–c.

Test apparently free, trochoid, conical; many long, narrow, arcuate chambers, four chambers in final whorl; whorls about eight in number; curve of dorsal side concave from apex to margin; ventral side concave with wide vestibule into which the aperture opens under a protecting flap.

Diameter, 0.7 mm. This is slightly smaller than the type.

Poverty Run limestone, Locality 6. Very abundant. Lower Mercer limestone, Localities 9, 11 and 13. Abundant.

Tetrataxis lata Spandel
Figures 37–39

Tetrataxis conica var. *lata* Spandel, 1901, Festschrift Naturhist. Gesell. Nuremberg, p. 186, figs. 6 a, b.

Tetrataxis lata Galloway and Rynicker, 1930, Oklahoma Geol. Survey Circ. 21, p. 17, pl. 3, figs. 3 a–c.

Test free, round, conical; ventral surface very slightly concave, slope of dorsal surface nearly straight from apex to margin; four to six whorls; five chambers in the last whorl each with a small, valvular projection extending into the vestibule.

Diameter, 0.59 mm.

Poverty Run limestone, Locality 6. Rare. Lower Mercer limestone, Localities 1, 9, and 11. Very abundant.

Family REOPHACIDAE Cushman 1917
Genus REOPHAX Montfort, 1808
Reophax asper Cushman and Waters
Figures 28–33

Reophax asperus Cushman and Waters, 1928, Cont. Cushman Lab. Foram. Res. vol. 4, p. 37, pl. 4, fig. 7.

Reophax asper Cushman and Waters, 1930, Univ. Texas Bull. 3019, p. 37, pl. 2, fig. 10.
Reophax asper, Plummer, 1945, Univ. Texas Bull. 4401, p. 226, pl. 17, fig. 23.

Test elongate, very gradually expanding, round in cross section; chambers set in a slightly curved row, sutures obscure; wall arenaceous, very rough, with coarse, angular sand grains and mica flakes; aperture small, terminal.

Average length, 0.51 mm.

Lower Mercer limestone, Locality 12. Common.

FIGURES 34–36. *Tetrataxis concava* Galloway and Rynicker
Dorsal, lateral and ventral views.
O. S. U. M. 19922, Poverty Run limestone, Loc. 6.

FIGURES 37–39. *Tetrataxis lata* Spandel
Dorsal, lateral and ventral views.
O. S. U. M. 19923, Lower Mercer limestone, Loc. 11.

FIGURES 40–41. *Ozawainella radiata* (Brady)
Lateral and apertural views.
O. S. U. M. 19925, Shale under Poverty Run limestone, Loc. 6.

FIGURES 42–43. *Ozawainella ciscoensis* (Harlton)
Lateral and apertural views.
O. S. U. M. 19924, Lower Mercer limestone, Loc. 12.

All figures X60 except Figs. 4, 5 and 6 which are X120.
All figured specimens are deposited in the Geological Museum of the Ohio State University.

Family FUSULINIDAE Möller, 1878
Subfamily OZAWAINELLINAE Thompson and Foster, 1937
Genus OZAWAINELLA Thompson, 1935
Ozawainella ciscoensis (Harlton)
Figures 42–43

Staffella ciscoensis Harlton, 1928, Journ. Paleontology vol. 1, p. 307, pl. 52, figs. 9 a–c.
Orobias ciscoensis Galloway and Harlton, 1928, Journ. Paleontology vol. 2, p. 350, pl. 45, figs. 11 a–c.

Orobias ciscoensis Galloway and Rynicker, 1930, Oklahoma Geol. Survey Circ. 21, p. 15, pl. 2, figs. 9 a, b.

Oribias ciscoensis Warthin, 1930, Oklahoma Geol. Survey Bull. 53, p. 22, pl. 2, fig. 1.

Test free, planispiral, involute, peripheral margin acute; chambers short, 20 to 25 in the last whorl; aperture a high narrow arch on the septal face.

Diameter, 0.34 mm., thickness 0.08 mm.

Poverty Run limestone, Localities 5 and 6. Very abundant. Lower Mercer limestone, Localities 12 and 13. Very abundant. Upper Mercer limestone, Locality 3. Very abundant.

Ozawainella radiata (Brady)

Figures 40–41

Involutina radiata Brady, 1869, Rep. Brit. Assoc. (Exeter) p. 379.

Endothyra radiata Brady, 1876, Pal. Soc. Mono. p. 97, pl. 5, figs. 10–12.

Orobias radiata Galloway and Harlton, 1928, Journ. Paleontology, vol. 2, p. 350, pl. 45, figs. 12 a–c.

Orobias radiata Galloway and Rynicker, 1930, Oklahoma Geol. Survey, Circ. 21, p. 14, pl. 2, figs. 8 a, b.

Similar to *O. ciscoensis* (Harlton) but with fewer chambers in the final whorl,—about 16. The test is also thinner in proportion to its diameter.

Diameter, 0.46 mm., thickness, 0.1 mm.

Poverty Run limestone, Locality 6, Very abundant. Lower Mercer limestone, Localities 12 and 13. Very abundant.

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SUCCESSION IN A DUNE COMMUNITY AT MENTOR HEADLANDS, OHIO

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Mentor Headlands is located west of the mouth of the Grand River on the shore of Lake Erie at Fairport, Lake County, Ohio. The general topography of the surrounding locale is that of a gentle slope underlaid by the soft, blue-gray Chagrin Shale, which weathers to a fine clay loam.

During pre-glacial times the Grand River had followed a northern route, but was later diverted parallel, westward, along the lake boundary by glacial deposits and emptied into Lake Erie three and one-half miles west of its present mouth (Levenett, 1902). The old river channel came closest to the lake shore where there was only a soft, low ridge. Resistance to erosion was low enough at this point to allow the river to break through to the lake and create the existing outlet of the Grand River. This resulted in a headland area being surrounded by the former river channel (fig. 1), which is now passing through hydroseral stages to dry land. Present drainage of the old channel has been considerably aided by the recent construction of a drainage ditch to the lake.

Although the nearby shore line of Lake Erie is in general an eroding one, with fairly high bluffs, a beach has developed west of the Grand's mouth, composed mainly of washed sand from the lake. This extends approximately one mile west along the lake border where it ends with the gradual increase of land elevation. This is the dune area under observation, which lies between parallels 41°45′ and 41°46′ north latitude, with an elevation range 584 ft. to 614 ft. above sea level.

METHODS

Four belt transects (fig. 2) were made extending from the beach, inland to the original shore line that existed previous to the accumulation of the present sand deposits. All of these transects were 60 ft. in width, with lengths ranging from 987 ft. to 1581 ft. An attempt was made to place the transects where they would yield the characteristic composition of the area. Trees and shrubs were grouped into classifications based on diameter at ground level and diameter breast high to furnish a reasonable account of invading species, those becoming established, and the older dominant and past dominant forms. Scattered herb samples were taken within the belt transects from quadrates of one square yard. The herb samples were obtained basically to furnish the general herb composition of the successional area as a whole. All data were recorded between the months of July and October 1952, with herb samples taken in September and October of that year.

DISCUSSION

The inshore currents of the lake have an easterly set and the prevailing winds are from the northwest. Lake sand is, therefore, gradually, being deposited along this particular portion of shore line, with constant exposure to wind resulting in dune formations. These dunes appear typical and similar in their formation to those described by Bower (1911) and Kurz (1942) who state that the pattern of dune formation is the result of wind-blown sand that settles or becomes lodged in a quiet spot, such as under a stone or around a living plant. Accumulation of sand and increase in dune size is aided considerably by plants whose growth extends horizontally as well as upward. When such plants are perennials, as the most common grasses and seedlings here are, the year to year accumulation results

FIGURE 1. Mentor Headlands, Ohio. The Grand River and its former channel are clearly visible.

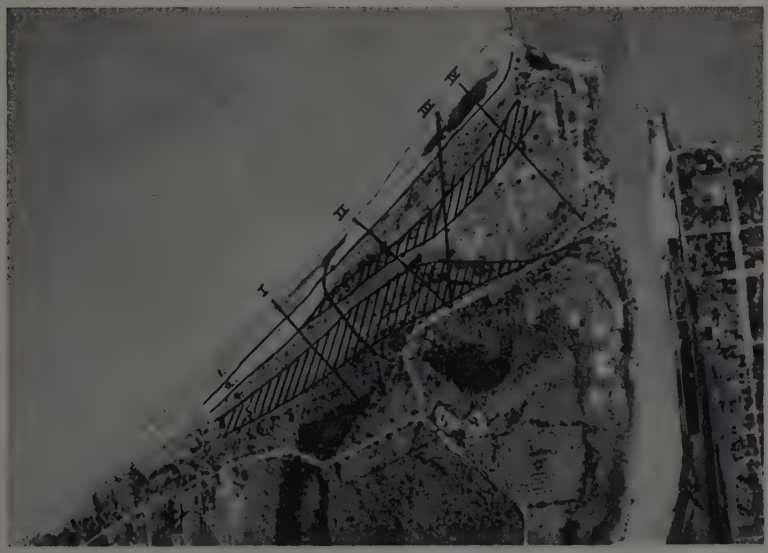

FIGURE 2. Dune community under observation. Illustrating location of the four belt transects and the six successional tree and shrub stages: 1. dune grass, 2. poplar, 3. poplar-aspen, 4. aspen. 5. aspen-oak, and 6. oak.

in gradual increase in the height of those dunes nearest the moving bare sand of the beach, while at the same time the extensive root systems anchor the dune, retarding its movement inland. In this case it means that the dune area has not extended inland by "moving dunes" or by "blowouts" and redeposition of the sand, partly because of the higher embankment along the former shore line and partly because of the relatively small area of the sandy beach. This series of dunes is the result of fairly recent sand deposition which has produced a change in the shore line. Inspection indicates that this deposition was brought about by the formation of the present river mouth and by breakwaters latter added, extending some 2700 ft. out into the lake. The older dunes, at the greatest distance from the bare beach,

TABLE 1

Frequency and percentage composition of shrubs and trees by stages in all four transects.

	STAGES											
	I		II		III		IV		V		VI	
	DUNE GRASS		POPLAR		POPLAR-ASPEN		ASPEN		ASPEN-OAK		OAK	
	No. per 1000 sq. ft.	%	No. per 1000 sq. ft.	%	No. per 1000 sq. ft.	%	No. per 1000 sq. ft.	%	No. per 1000 sq. ft.	%	No. per 1000 sq. ft.	%
Populus nigra var. italica (Muenchh)	.42	9.2	14.41	88.4	11.69	59.7	.07	.6	..	....	..	....
Populus tremuloides (Michx.)	1.92	42.1	1.43	8.7	3.77	19.2	8.42	78.9	3.16	23.0	1.03	6.8
Salix nigra (Marsh)	2.03	44.5	.34	2.0	.38	1.9	.80	7.5	.57	4.3	.06	.3
Ptelea trifoliata (L.)	....	....	.06	.3	.26	1.3	.39	3.6	2.80	20.4	.56	3.7
Quercus rubra (L.)	....	....	....	....	.03	.1	.19	1.7	3.60	26.3	6.92	45.8
Quercus coccinea (Muenchh)	....	....	....	....	....	....	.02	.1	.42	3.0	.63	4.1
Fraxinus americana (L.)	....	....	....	....	....	....	.02	.1	.08	.5	1.50	9.9
Quercus Michauxii (Nutt.)	..	..	..	..	....	....	....	....	40	2.9	1.10	7.2
Viburnum dentatum (L.)	....	....	....	....	....	....	....	....	....	....	2.00	13.3
Populus alba (L.)	....	....	....	....	3.40	17.3	....	....	....	....	....	....
Others	.19	4.1	.05	.3	.04	.2	.75	7.0	2.65	19.2	1.27	8.4
TOTALS	4.56		16.29		19.59		10.66		13.68		15.07	

are firmly held in place by vegetation. They seem to be considerably flattened by erosion and to be beyond the point of growth by accumulation of blowing sand.

A definite successional pattern is present in the dune community. Extending from the bare beach area, where no plants were present, the following associations are recognizable: (1) dune grass, (2) poplar, (3) poplar-aspen, (4) aspen, (5) aspen-oak, and (6) oak. The developmental succession begins with the bare beach and then proceeds through the four major stages; (1) dune grass, (2) poplar, (4) aspen, and (6) oak. These occur in parallel associations along the entire dune community (fig. 2). Only the two ecotones marked stages three and five do not extend the entire length of the area. The shrub and tree composition in all the stages, taken from the transects, are listed in tables 1 and 2.

Primary invasion of the dunes is by the willows, *Salix nigra* and *Salix fragilis*, forming their colony-like assemblages along the beach. Where there are lagoons,

such as is crossed by two of the transects, the willows cluster within and about the lagoon area. It is only here, in the dune grass stage, that the willows appear in any large numbers. Throughout the general area scattered willow colonies appear in various sizes and age classifications, while maintaining a low but uniform distribution.

TABLE 2

Total numbers of individual shrubs and trees in each stage, from all four transects.

SPECIES	STAGES I Dune Grass	II Poplar	III Poplar-Aspen	IV Aspen	V Aspen-Oak	VI Oak	
Total Area	35,390 sq. ft.	75,900 sq. ft.	26,160 sq. ft.	82,050 sq. ft.	58,860 sq. ft.	29,880 sq. ft.	Totals
Populus tremuloides (Michx.)	68	109	99	691	186	31	1184
Salix nigra (Marsh.)	72	26	10	66	34	2	210
Populus nigra-italica (Muenchh)	15	1094	306	6	0	0	1321
Salix fragilis (L.)	6	4	0	12	15	0	37
Ptelea trifoliata (L.)	....	5	7	32	165	17	226
Quercus rubra (L.)	....	....	1	16	212	207	436
Populus alba (L.)	....	....	89	0	0	0	89
Morus alba (L.)	....	....	1	0	0	0	1
Fraxinus americana (L.)	....	....	....	2	5	45	52
Crataegus albicans (Ashe)	....	....	....	3	1	1	5
Ligustrum vulgare (L.)	....	....	....	5	6	1	12
Syringa vulgaris (L.)	....	....	....	1	103	6	110
Quercus coccinea (Muenchh)	....	....	....	2	25	19	46
Ilex verticillata (L.)	....	....	....	6	0	0	6
Rhus typhina (L.)	1	....	....	11	3	0	15
Prunus serotina (Ehrh.)	....	....	....	1	0	0	1
Quercus alba (L.)	....	....	....	7	0	0	7
Quercus Michauxii (Nutt.)	....	....	....	....	24	33	57
Ulmus fulva (Michx.)	....	....	....	....	5	8	13
Acer saccharum (Marsh.)	....	....	....	....	4	10	14
Carya ovata (Mill.)	....	....	....	....	8	5	13
Crataegus Macauleyae (Sarg.)	....	....	....	....	5	4	9
Crataegus Crus-galli (L.)	....	....	....	....	1	0	1
Crataegus macrosperma (Ashe)	....	....	....	....	2	0	2
Ulmus americana (L.)	....	....	....	....	1	0	1
Tilia heterophylla (Vent.)	....	....	....	....	1	0	1
Salix longifolia (Marsh.)	....	....	....	....	1	0	1
Salix candida (Flugge)	....	....	2	....	....	0	2
Viburnum dentatum (L.)	....	....	....	....	....	60	60
Acer rubrum (L.)	....	....	....	....	....	1	1
Cornus Amomum (Mill.)	....	....	....	....	....	1	1
Pyrus angustifolia (Ait.)	....	....	....	....	....	1	1
TOTALS	162	1238	515	861	807	452	3935

Scattered growth of *Populus nigra* var. *italica* occurs along the sand dunes, but large stands of this tree lie beyond the beach representing the first tree stage of the succession. Since it is known only in staminate form, reproduction is by sprouts and the presence of large concentrations of this tree is common. The poplar is the most numerous tree of the entire community even though it does not appear in the later stages of the succession. Distribution is heavy (88%, table 1.) in the poplar stage, then gradually decreases, ending abruptly at the aspen-oak association.

Rapid invasion into the poplar community is accomplished by *Populus tremuloides*. This results in an ecotone formation of poplars and aspens, followed directly by the aspen stage. *Populus tremuloides* composes the central stand of the entire seral development, being found in large numbers as early invaders of the sand dunes and as a well-established component of latter successional stages. Abundant distribution is common in all areas, reaching its peak of 78 percent (table 1) in the aspen community.

Reference was made previously to the original coastline. Along this area are large stands of oaks, along with many older aspens. This is the center of the oak stage. It is under the influence of two successional patterns. One of these is the sand dune succession from the shore line, and the other, the swamp succession of the former river bed. The oaks have gradually begun their invasion toward the lake, already establishing an ecotone stage between the oak and aspen concentrations.

As the tree and shrub stages change, there is a gradual corresponding change in the invaders and subdominant species of herbs. This was not clearly zoned to correspond with the tree stages, nor was this uniform. The dune grass area, although showing the most sparse scattering of herbs along the dunes and lagoons, or under the protection of small trees, contained a wide variety of species. Large stands of dune grass (*Ammophila arenaria*) grow along the entire dune area, also *Equisetum prealtum* and *Equisetum arvense* were common throughout the community. The weed or crop plant, *Melilotus alba*, is the main herb dominant of stages three and four. *Rhus toxicodendron* is well established throughout the entire oak stage.

SUMMARY

The accumulation of lake sand at the mouth of the Grand River resulted in the formation of a sandy beach. As the beach developed, dunes were shaped by wind action and occasionally trapped small areas of water, forming lagoons. The dunes and lagoons provided anchorage and shelter for various herbs and grasses. These early invaders began a successional pattern which later enabled the larger shrub and tree growth to become established.

In order to obtain the shrub and tree composition of the sand dune community, four belt transects were made; each began at the shore and were directed inland. Regardless of their position, all transects revealed identical sequence in the zonation of shrubs and trees in this dune succession, forming stratal stages extending from the beach inland. These established communities, named after the dominant species, were: dune grass, poplar, aspen, and oak. Two ecotones occurred which did not develop the entire length of the dunes, one between the poplar and aspen stage, and the other between the aspen and oak stages.

Using evidence of other local successional patterns and the present climatic conditions as a basis for judgment, a deciduous forest of beech-maple composition appears to be the probable climax of this successional pattern. Before this state is reached however, various groupings of mixed deciduous species will occur. Stages five and six furnish evidence for this development already. Possibly, an oak-hickory association could become one of the stages of fairly long duration during this period, if the drainage of the area improves.

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A SYNOPSIS OF *MICRALCINUS* LECONTE
(COLEOPTERA, CURCULIONIDAE)

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This is the first in a series of papers which will eventually consider the whole of the old subfamily Cryptorhynchinae occuring in North America. One or more closely related genera will be considered in each paper. The last paper will contain the keys to the tribes and genera. This method has been resorted too in order to facilitate publication.

Micralcinus LeConte

Micralcinus LeConte 1876, p. 235. Blatchley and Leng 1916, p. 494. Buchanan 1927, p. 108.

Rostrum received in the prosternum in repose; the pectoral canal not extending behind the anterior coxae and not closed behind. Funicle 7-segmented, first segment robust and subequal to second. Club densely pubescent. Prothoracic lobes strongly developed. Elytral intervals flat or very feebly convex. Anterior coxae narrowly separated; mesosternum protuberant. Femora slender, sinuate beneath. Claws free, divergent and with a minute tooth at basal third of each.

Genotype. Miracalcinus cribratus LeConte.

The body form and general morphology is typically Ithyporid and the genus is properly placed after *Conotrachelus* as was done by LeConte and Buchanan. The funicle is definitely 7-segmented contrary to statements otherwise by Blatchley.

All previous authors have considered the claws to be free, divergent and simple. However, examination under magnifications of from 60x to 90x show the claws to have a minute tooth at about the basal third of each claw. All members of the genus actually have minutely toothed claws.

External sexual differences (as indicated by Buchanan, *l.c.*) are easily noted. They are: ♂ with concavity at the base of the abdomen and the fore tibiae distinctly arcuate; ♀ with the last abdominal segment deflexed upward and transversely depressed across apical fifth. The author has noted that in most collections the ♀ outnumber the males about 3–1.

A large number of the specimens examined were taken at light near bodies of water.

KEY TO THE SPECIES OF *Micralcinus*.

1. Femora completely unarmed, without even a minute denticle on the hind pair..... 2
1'. Femora armed with a small tooth or denticle which is often more prominent on the hind pair..... 3
2. Third. and fourth funicular segments subequal; rostrum moderately arcuate on dorsal edge in profile; punctures of elytral series moderate, not nearly as wide as the intervals ..... *cribratus* LeConte
2'. Third segment of funicle longer than fourth; rostrum very feebly arcuate on dorsal edge in profile; punctures of elytral series coarse, nearly or as wide as the elytral intervals..... *maculatus* (Blatchley)
3. Elytra without erect seta-like scales on the elytra; femora with a very small denticle; more elongate species..... *kalmbachi* Buchanan
3'. Elytra with erect, bristly, seta-like scales on all elytral intervals; femora with a tooth which is readily visible; shorter more robust species..... *stehri* n. sp.

Micralcinus cribratus LeConte

Micralcinus cribratus LeConte 1876, p. 236. Blatchley and Leng 1916, p. 494. Buchanan 1927, p. 108.

Elongate-oval; dark reddish brown with the elytra mottled with black; moderately clothed with elongate, prostrate, white seta-like scales which on the elytra are condensed in spots giving a mottled appearance, prominent patches at the bases of 3rd intervals and on humeri.

Rostrum stout, about as long as prothorax, moderately arcuate on dorsal edge in profile, deeply striate and punctured. First funicular segment robust, subequal to 2nd; 3rd segment shorter than 2nd; 3rd and 4th subequal. Head rather densely punctured. Front with a small round deep fovea between the eyes.

Prothorax as wide as long, sides subparallel in basal two-thirds, then narrowed to a feeble apical constriction; pronotum cribrately punctured, the punctures coarse and deep. Scutellum small and triangular.

Elytra oval, about one-third wider than the prothorax; bisinuate at base; humeri rounded; sides slightly rounded, more strongly convergent apically; striae feebly impressed, composed of rather large, deep punctures, which become smaller apically; intervals flattened.

Ventral side strongly, moderately densely punctured, sparsely clothed with setae. Femora slender, sinuate beneath and unarmed. Anterior tibiae of ♂ distinctly arcuate, of ♀ straight. Male with a concavity at base of abdomen, the ♀ with the last abdominal segment deflexed upward and transversely depressed across apical fifth.

Length 3.2–4.7 mm., width 1.2–2.3 mm.

Type locality. Capron, Florida. Type in the LeConte Collection at the Museum of Comparative Zoology, Cambridge, Massachusetts.

Distribution. Known only from Florida.

Material examined. Examples have been seen from Moore Haven, VI–4–18; Belle Glade, VII–26; Enterprise; Tarpon Springs; Sebring, VI; all in the State of Florida.

Since the above was written additional material from the Florida State Plant Board has been studied and additional localities are added herewith: Miami, V–1–39, I–9–43, V–5–39; Florida City, V–1–39. A total of 34 examples were examined. Seventeen of this number were taken at light. Examples from Florida City were on *Amaranthus* sp. Those from Miami were on *Acnidia cuspidata.*

Superficially resembling a rather robust *Tyloderma variegata* (Horn). This is by far the more common of the four species recognized.

Micralcinus maculatus (Blatchley) n. comb.

Tyloderma maculata Blatchley, Blatchley and Leng 1916, p. 491.

Elongate-oval, robust; dark reddish brown, the elytra mottled with black and the antennae and tarsi pale reddish brown; head, rostrum and prothorax moderately clothed and the elytra thickly clothed with prostrate, elongate seta-like scales which on the latter are condensed in spots, prominent patches present on the bases of 3rd elytral intervals and on humeri.

Rostrum nearly as long as head and prothorax, very feebly arcuate on dorsal edge in profile, carinate at middle, finely striate laterally, coarsely and densely punctured. Funicle 7-segmented, the first segment robust, subequal to 2nd which is more slender, 3rd segment shorter than 2nd, longer than 4th. Head finely and closely punctured. Front with a small, round, deep fovea between the eyes.

Prothorax a little wider than long, sides nearly straight, very slightly convergent to apical third then feebly narrowed to apex; pronotum densely, coarsely and rather evenly punctured. Scutellum small and broadly triangular.

Elytra oval, one-fourth wider at base than prothorax, emarginate at base, sides feebly converging from base to behind middle, then rapidly converging to apex; humeri obliquely rounded; striae unimpressed, strial punctures rather coarse, cutting into intervals; the latter very feebly convex.

Ventral side sparsely and more finely punctured than the dorsum, each puncture with a fine, gray, prostrate seta. Abdominal segments as in *cribratus.* Anterior tibiae of ♀ straight and shorter than the femora.

Length 4.0–4.5 mm., width 1.8–2.1 mm.

Type locality. Little River, Florida. Type in the Blatchley Collection, Purdue University, Lafayette, Indiana.

Distribution. Known only from Central and Southern Florida.

Material examined. Only three examples known: Little River, III–17, (holotype); Moore Haven, III–3, W. S. Blatchley; Hog Island, Dunedin, III–26–18, W. S. Blatchley. The latter example was swept from *Batis maritima* L.

The author was surprised to find that *Tyloderma maculata* Blatchley was actually a *Micralcinus*, and is not a little puzzled as to why Blatchley made the error. There is no evidence of a pectoral canal behind the anterior coxae, nor is the pectoral canal closed behind. The funicle is definitely 7-segmented while in *Tyloderma* it is 6-segmented. The general form and morphology is definitely Ithyporid.

Micralcinus kalmbachi Buchanan

Micralcinus kalmbachi Buchanan 1927, p. 169.

Oblong; reddish brown, the elytra mottled with black; sparsely unevenly clothed with narrow, prostrate, white seta-like scales, which on the elytra are condensed in a patch at base of 3rd interval, and tending to form spots and bands; the odd intervals with a single row of unevenly placed suberect setae.

Rostrum sub-cylindrical, evenly arcuate, feebly carinate along median line, feebly strigose laterally, rugosely punctured; very feebly set off from the head. Head coarsely and closely punctured. Front coarsely foveate between the eyes. Eyes moderately convex.

Prothorax slightly wider than long, sides slightly converging from middle to base, very feebly constricted at apex; pronotum cribrately punctured. Scutellum small, elongate, narrow and rounded behind.

Elytra elongate, one-fourth wider at base than prothorax, feebly bisinuate at base, sides subparallel to behind middle then convergent to the apex; humeri rounded and prominent; striae unimpressed except near declivity, punctures rather large and close, not cutting into the intervals; intervals nearly flat, becoming feebly convex, the first more prominent, at declivity.

Ventral side darker than dorsum, sparsely clothed with suberect setae; punctures coarse and rather sparse, becoming finer and denser on the fifth abdominal segment. Anterior tibiae of ♀ nearly straight, shorter than the femora. Femoral tooth only a denticle, more prominent on the posterior legs, scarcely visible on anterior pair.

Length 4.2–4.3 mm., width 1.9–2.0mm.

Type locality. Gueydan, Louisana. Type in the United States National Museum.

Distribution. Louisiana and Alabama.

Material examined. Louisiana: Gueydan, VIII–5–25, E. R. Kalmbach, (holotype and paratype), in the United States National Museum; New Orleans, VIII–8–38, in the author's collection. *Alabama:* Mobile. Eight examples have been studied, all of which were female and collected at light.

Micralcinus stehri n. sp.

Female.—Robust; dark reddish, the elytra paler and mottled with black; moderately densely clothed with prostrate brown, black and white seta-like scales, the head and pronotum with a few scattered erect seta-like scales and the elytra with a single row of erect scales on each interval, a prominent patch of white scales present on bases of 3rd intervals and humeri.

Rostrum nearly as long as head and prothorax combined, subcylindrical, feebly curved; coarsely punctured; carinate along median line, feebly striate laterally; feebly set off from head. Antennae inserted near apical third of rostrum. Funicle 7-segmented; first segment robust, subequal to 2nd which is slender; 3rd segment longer than 4th; remainder moniliform, gradually increasing in size. Club elongate, oval and densely pubescent; strongly annulated. Head closely, coarsely, rather shallowly punctured, the intervals between the punctures strongly alutaceous. Front with a round, deep fovea. Eyes feebly convex and coarsely granulated.

Prothorax slightly wider than long, the sides parallel in basal two-thirds then converging to apex; the sides feebly sinuate at middle; pronotum closely, coarsely, deeply and evenly punctured, each puncture with a seta-like scale; prothoracic lobes very prominent. Scutellum small and triangular.

Elytra about one-third longer than wide, sides parallel to apical third, then convergent to apex; humeri oblique; striae impressed, strial punctures about half the width of intervals, rounded, deep, about one-half their diameter apart; intervals very feebly convex, confusedly punctured, each interval with a row of erect seta-like scales which are separated by almost one and one-half their length.

Ventral side coarsely closely punctured, those of the 5th abdominal segment finer and denser, each with a recumbent white seta, the intervals between the punctures strongly alutaceous. Mesosternum moderately protuberant and produced forward. Legs moderately robust, densely clothed with white scales. Femora prominently armed with a tooth. Anterior tibiae of ♀ straight. Claws free, divergent and minutely toothed at basal third.

Length 3.6 mm., width 1.75 mm.

Male.—Differs very little from the female, other than by the usual sexual differences. The anterior tibiae not distinctly arcuate as in the genotype. Length 3.3 mm., width 1.7 mm.

Type locality. New Orleans, Louisiana. Type in the author's collection.

Distribution. Louisiana, Mississippi and Alabama.

Type material. Holotype, ♀, New Orleans, Louisiana, VII–20–44, J. H. Hughes in the author's collection. Allotype, ♂, Mobile, Alabama, VI-23-50, E. D. Wilson, in the collection of B. D. Valentine. Eight paratypes as follows: in the author's collection, 3 ♀, same data as holotype; in the collection of B. D. Valentine, 2 ♀, same data as allotype, 3 ♀, Hattisburg, Mississippi, VII–12–52, C. B. Segars. Length of paratypes 3.3–3.8 mm., width 1.5–1.8 mm. All examples were taken at light.

This species differs from all other species in the genus by the erect seta-like scales, and the other characters mentioned in the key.

This species is named in honor of Dr. W. C. Stehr of Ohio University, Athens, who has kindly given the author many Curculionidae for his collection and who donated the types of this species to the author.

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Buchanan, L. L. 1927. Notes on some light attracted beetles from Louisiana (Coleop.). Ent. News 38: 165–170.

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Animal Control in Field, Farm and Forest. *Robert W. Eadie.* The Macmillan Company, New York. 1954. viii+257 pp. $3.75.

Dr. Eadie has compiled what his publishers call "the world's first practical guide to the effective control of animals that damage man's properties."

The book treats the animals by taxonomic groups and discusses life history, economic importance, control and natural enemies for each animal.

The material on control is as scientifically grounded as the available information permits. Much of the recommended control consists of common sense use of protective construction and destruction of the offending individuals. Chemical repellents are recommended in a number of cases. Only in the case of rats, meadow mice and certain western rodents are intensive poisoning campaigns suggested.

The author states that life history information is necessary for intelligent control measures but is unable to produce any significant ecological approaches to control. However, the economic, ecologic and aesthetic values of most animals are pointed out. The predators, except for the vagrant house cat, benefit from this effort.

Dr. Eadie is to be praised for the intelligent, objective approach shown in this successful effort to collect most of the available information on animal control in one book. His work will be of great value to biologists, agriculturists, and horticulturists. Its popular value may be limited by the lack of illustrations, by the comprehensive reference style, and by the failure to include guides for identifying and evaluating types of damage.

R. K. Davis

ALGAE OF THE PANAMA CANAL AND ITS TRIBUTARIES
I. FLAGELLATED ORGANISMS

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Although the Panama Canal very well might be considered as an ecological entity, it has been pointed out (Prescott, 1951) that there is considerable variation in water chemistry and other factors throughout the length of the Canal. These differences are correlated with variations in the algal flora in different areas and reaches so that a survey has resulted in an extensive and heterogeneous list of species. Inasmuch as few reports have been made on the algal flora of the Canal (Ostenfeld and Nygaard, 1925; Prescott, 1936, 1951; Drouet, 1937), the author proposes to deal with the species taxonomically in a series of papers of which this is the first. Herein are considered the flagellate members of several Divisions of algae, Chlorophyta, Chrysophyta, Euglenophyta, Pyrrhophyta which appear in collections to date. It is hoped that such a treatment will be of interest not only to the general phycologist, but also to others concerned with the aquatic biology of the Canal, particularly those interested in the food chain and feeding of aquatic animals including mosquito larvae.

As mentioned before (Prescott, 1951) the taxonomic work is based upon collections made by the author in 1938, and those of Drs. G. W. Martin, Carol Dodge, and A. M. Chickering. The author also made a few additional collections in January, 1953.

CHLOROPHYTA

Chlamydomonas incerta Pascher

Cells spherical or nearly so, inclosed in a relatively close gelatinous membrane without apical papilla; chloroplast semi-reticulate, covering most of the wall, with a prominent basal pyrenoid; pigment-spot lateral in the anterior end; cells 17.5 μ in diameter. Pl. 5, Fig. 6.

CZ–209. Rio Chilibres.

The genus *Chlamydomonas* is undoubtedly represented by many species in the Panama Canal region, but *C. incerta* is the only one which has appeared in collections. Of the globular species which have no apical papilla this is the largest. The chloroplast is definitely cup- or urn-shaped and (in ours) padded and somewhat reticulate.

Gonium pectorale Müller

Cells broadly elliptic or egg-shaped, arranged in one plane to form flat, somewhat rectangular plates, usually 16 cells in each colony; cells with the narrower pole extended outwardly and with flagella of the marginal cells directed parallel with the plane of the colony, interior cells with flagella directed at right angles to the colonial plane; colonial mucilage wide and reticulate, each cell being inclosed in a sheath interconnected with sheaths of neighboring individuals by narrow processes so that interstices are produced; chloroplast cup-shaped with a basal pyrenoid; pigment-spot anterior and lateral; colony swimming in a tumbling fashion; cells 8–10 μ in diameter, 12–14 μ long. Pl. 6, Fig. 4.

CZ–211. Rio Chagres.

Eudorina elegans Ehr.

Colony oval or subspherical, with a wide gelatinous sheath; cells spherical, arranged at the periphery of the colonial envelope, usually in transverse tiers; chloroplast cup-shaped with a basal or central pyrenoid; pigment-spot lateral in the apical region; the two flagella parallel as they pass through the colonial mucilage and then widely divergent; cells averaging 12 μ in diameter. Pl. 6, Fig. 5.

This very common and widely distributed species was found to be very abundant in the plankton of Gatun Lake, often occurring with *E. unicocca* G. M. Smith in several regions of the Canal.

Eudorina interconnexa sp. nov.

Colony oval, the gelatinous sheath wide and sometimes slightly produced to form lobes posteriorly; cells spherical, 32 in number, bearing a pair of prominent gelatinous canals anteriorly through which the flagella extend; cells inclosed in individual sheaths which are interconnected with neighboring cells by slender strands so that a fenestration is formed within the colonial mucilage; cells. 10–18.5 μ in diameter; colony 89 μ in diameter. Pl. 6, Fig. 3.

CZ–26; CZ–34. Gatun Lake plankton, especially in Gigante Bay.

This species is similar to *E. elegans* in most respects but differs in the possession of individual cell sheaths which are interconnected. In none of the colonies do the cells show the tiered arrangement characteristic of *E. elegans*. Another characteristic which is presumed to be specific is the possession of canal-like processes through which the flagella extend. These show particularly in preserved material.

Colonia ovata, vagina gelatinosa lata, interdum, ad lobos postice formandos, aliquantum producta; cellulae sphericae, 32 numero, pari fossarum gelatinosarum manifestarum per quas flagella egrediuntur antice praeditae; cellulae in vaginis singulis, per ligamenta tenuia cellulis propinquis interconnexis, fenestrationem intra mucilaginem colonialem formantes, inclusae; cellulae 10–18.5 μ diam., colonia 89 μ diam.

Eudorina unicocca G. M. Smith

Colony irregularly pyriform or ovate, the sheath wide and narrowed slightly posteriorly where it becomes somewhat extended to form four broad lobes; cells 24–32 in number, spherical or broadly oval, (in ours), with a pair of prominent canals through which the flagella extend; cells rather closely arranged in about 4 tiers within the colonial envelope; cells 10.8 μ in diameter. Pl. 5, Fig. 13, 14.

CZ–26. Found only in the plankton of Gatun Lake where it occurs with *E. elegans*.

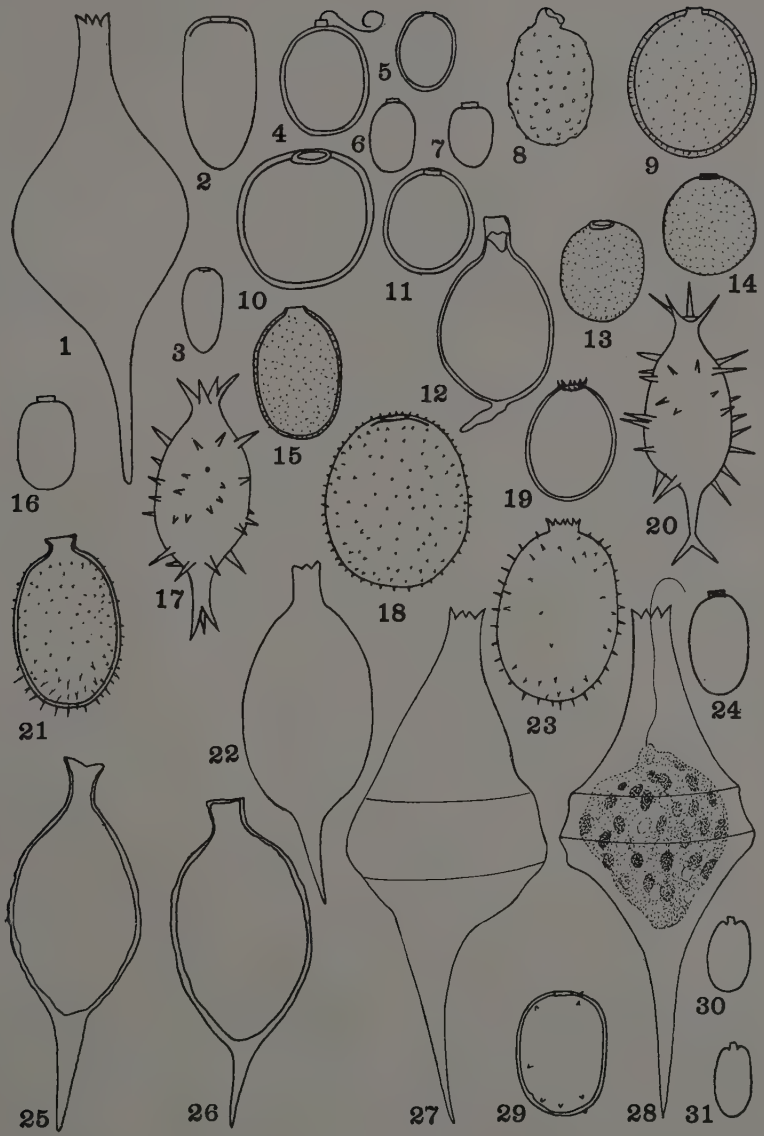
Pleodorina californica Shaw

Colony spherical, with 64–128 spherical or ovate, flagellated cells of two sizes, the smaller cells being located in the posterior region of the colony, the larger (about half the total number) being reproductive and located anteriorly in the colony; larger cells 10–14–(23) μ in diameter, smaller cells 8–11 μ in diameter; large colonies up to 400 μ in diameter. Pl. 6, Fig. 7.

CZ–204. Plankton in Gatun Lake.

EXPLANATION OF FIGURES IN PLATE I

1. *Trachelomas ensifera* var. *dentifera* var. nov.
2–3. *Trachelomonas cylindrica* var. *decollata* Playf.
4. *Trachelomonas Manginii* Defl.
5. *Trachelomonas oblonga* Lemm.
6–7. *Trachelomonas oblonga* var. *attenuata* Playf.
8. *Trachelomonas scabra* var. *longicollis* Playf.
9. *Trachelomonas Kelloggii* var. *punctata* Skv.
10. *Trachelomonas Dybowskii* Drez.
11. *Trachelomonas Dybowskii* Drez. Fa.
12. *Trachelomonas fluviatilis* var. *curvicauda* var. nov.
13. *Trachelomonas intermedia* Dang.
14. *Trachelomonas volvocina* Ehr.
15. *Trachelomonas hispida* var. *punctata* Lemm.
16. *Trachelomonas cylindrica* Ehr.
17. *Trachelomonas speciosa* var. *spinosa* var. nob.
18. *Trachelomonas hispida* (Perty) Stein
19. *Trachelomonas hispida* var. *papillata* var. nov.
20. *Trachelomonas pisciformis* sp. nov.
21. *Trachelomonas subflava* sp. nov.
22. *Trachelomonas fluviatilis* var. *curvata* Lemm.
23. *Trachelomonas hispida* var. *coronata* Lemm.
24. *Trachelomonas pulcherrima* var. *latior* fa. *collarita* fa. nov.
25–26. *Trachelomonas fluviatilis* var. *rugosa* var. nov.
27–28. *Trachelomonas napiformis* sp. nov.
29. *Trachelomonas hispida* var. *papillata* var. nov.
30–31. *Trachelomonas pulcherrima* ver. *elevatum* var. nov.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Pleodorina illinoisensis Kofoid

Colony spherical or subspherical, with 32 to 64 spherical or broadly oval, flagellated cells arranged near the periphery, 4 of the cells being distinctly smaller and located at the posterior pole or to one side of the colony; larger cells 16 μ in diameter, smaller vegetative cells 11.5 μ in diameter. Pl. 6, Fig. 8.

CZ–56; CZ–26. Plankton of Gatun Lake, near Orchid Island.

Pascher (1927) has reduced the name of this organism to *Eudorina illinoisensis* (Kofoid) Pascher.

Volvox aureus Ehr.

Colony relatively large, spherical, with as many as 3200 ellipsoidal, flagellated cells arranged at the periphery of the colonial mucilage, colony visible to the unaided eye; cells without individual sheaths, the intercellular processes usually fine and sometimes difficult of determination; colonies usually dioecious; daughter colonies 2–4–(6) within the parent colony; female colonies with as many as 21 eggs; male colonies with many cells (sometimes one-half of the individuals) forming spermatozoid bundles; cells 4–8 μ in diameter; zygotes with smooth walls, 32–62 μ in diameter. Pl. 7, Fig. 1.

CZ–2. Plankton in Gatun Lake.

EUGLENOPHYTA

Euglena acus Ehr.

Cells elongate-cylindric, narrowed anteriorly, with the apex truncate and slightly bilobed; narrowed posteriorly to form a relatively long, sharply pointed caudus; pellicle spirally striated (sometimes very faintly so); chloroplasts numerous, somewhat irregularly shaped discs, often showing in slightly spiral rows just within the pellicle; paramylum in the form of 2 to several slender, elongate rods (sometimes with many short rods intermingled among the larger); flagellum short, ¼ or less of the cell in length; swimming without changing shape; cells 6.8–11.9 μ in diameter, 85–108 μ long. Pl. 4, Fig. 17, 18; Pl. 5, Fig. 5.

CZ–206; CZ–197. Rio Chagres.

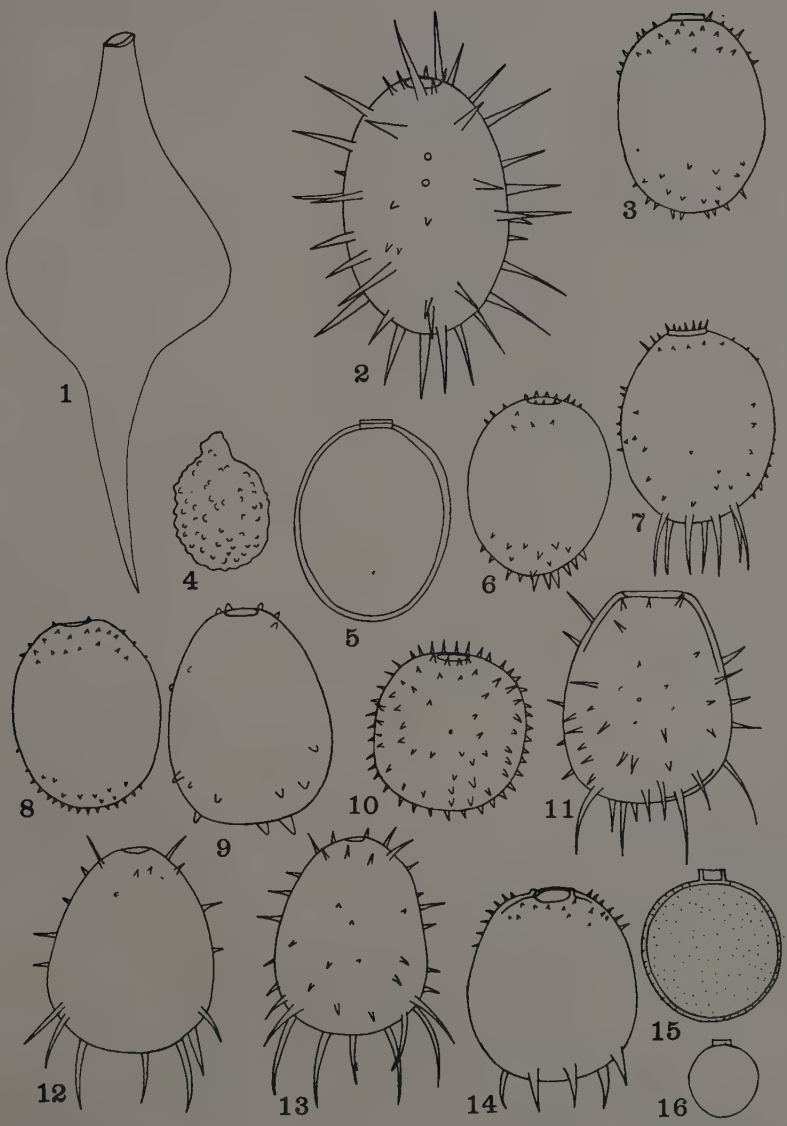
Euglena intermedia (Klebs) Schmitz

Cells elongate-cylindric, rather stout, little if at all narrowed anteriorly but broadly rounded and slightly bilobed at the apex, posteriorly narrowed abruptly to form a short, slightly curved caudus; pellicle spirally striated or smooth; chloroplasts numerous circular or oval discs; paramylum 2 large and long, or many shorter rods; flagellum less than ⅓ of the cell in length; swimming either straight and rigid or with metaboly; cells 12–17 μ in diameter (20 μ when contracted), 78–108 μ long. Pl. 5, Fig. 3, 4.

CZ–84. Pond in U. S. Government Experimental Gardens, C. Z.

EXPLANATION OF FIGURES IN PLATE II

1. *Trachelomonas ensifera* Daday.
2. *Trachelomonas spectabilis* Defl.
3. *Trachelomonas superba* Swir. Fa.
4. *Trachelomonas similis*. Stokes.
5. *Trachelomonas Lefevrei* var. levis var. nov.
6. *Trachelomonas armata* var. *Steinii* Lemm.
7. *Trachelomonas armata* var. *longispina* Playf.
8. *Trachelomonas hispida* var. *duplex* Playf.
9. *Trachelomonas armata* fa. *paucispina* fa. nov.
10. *Trachelomonas armata* var. *longispina* Playf.
11. *Trachelomonas armata* var. *ovata* fa. *truncata* fa. nov.
12. *Trachelomonas armata* var. *longispina* Playf.
13. *Trachelomonas armata* var. *longispina* Playf. Fa.
14. *Trachelomonas armata* var. *ovata* Swir.
15. *Trachelomonas Wermelii* Skv.
16. *Trachelomonas Wermelii* var. *paludosa* Skv.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Euglena longicaudata sp. nov.

Cells elongate-cylindric, slightly metabolic, broadly rounded and bilobed anteriorly with a prominent furrow extending nearly the entire length of the body, tapering posteriorly to a long, colorless, pointed tail-piece; membrane spirally striated with fine, double striae; chloroplasts very numerous, ovoid discs; paramylum bodies of various forms but usually 4 ovoid discs, sometimes lenticular, or rod-shaped bodies, two lying anterior and two posterior to the large ovoid, centrally placed nucleus; pyrenoids (?); a large vacuole just posterior to the groove in the anterior end; pigment-spot (?); 34–36 μ in diameter, 296–340 μ long. Pl. 3, Fig. 10–12.

CZ–87. Pond in U. S. Government Experimental Gardens.

This large species should be compared with *E. oxyuris* Schmarda and *E. antefossa* Johnson. From the latter it differs in the type and arrangement of the striations and in the shape of the paramylum bodies. Also the tail piece is much longer in the Panama specimens and the posterior end is more gradually tapering. *Euglena oxyuris* Schmarda has a different shape of paramylum grain and it also has a shorter, more abruptly tapering caudus. Drezepolski (1925) describes rather incompletely a similarly shaped species, *E. gigas*, which differs in having long narrow, rod-shaped paramylum bodies, and in not having the long, colorless tail-piece characteristic of the Panama organism.

Cellulae elongato-cylindricae, paululum metabolicae, antice late rotundatae atque bilobatae, sulco perspicuo paene per totam longitudinem corporis extenso praeditae, in caudam longam, incoloratam, acuminatam postice attenuatae; membrana striis tenuibus duplicibus spiraliter striata; chloroplasti plurimi, ovato-disciformes; grana paramylacea forma variantia, plerumque, autem, 4 ovato-disciformia, lenticularia aut bacilliformis, duobus anterioribus, duobus posterioribus nucleo magno centrali ovato adiacentibus; pyrenoidea (?); vacuola magna admodum posterior sulco in extremitate anteriore adiacente; stigma pigmenti (?); cellula 34–36 μ lat., 296–340 μ long.

Euglena oxyuris Schmarda

Cells elongate, subcylindrical and spirally twisted, truncate and broadly rounded at the anterior end, posteriorly tapering to a long, straight, colorless caudus; pellicle spirally striated; chloroplasts numerous oval platelets; paramylum in the form of two large, subcylindrical links and many smaller circular plates; flagellum about $\frac{1}{3}$ of the cell in length; pigment-spot large and conspicuous; 40–71 μ in diameter, 170–192 μ long. Pl. 5, Fig. 11.

CZ–206. Rio Chagres.

Euglena polymorpha Dangeard

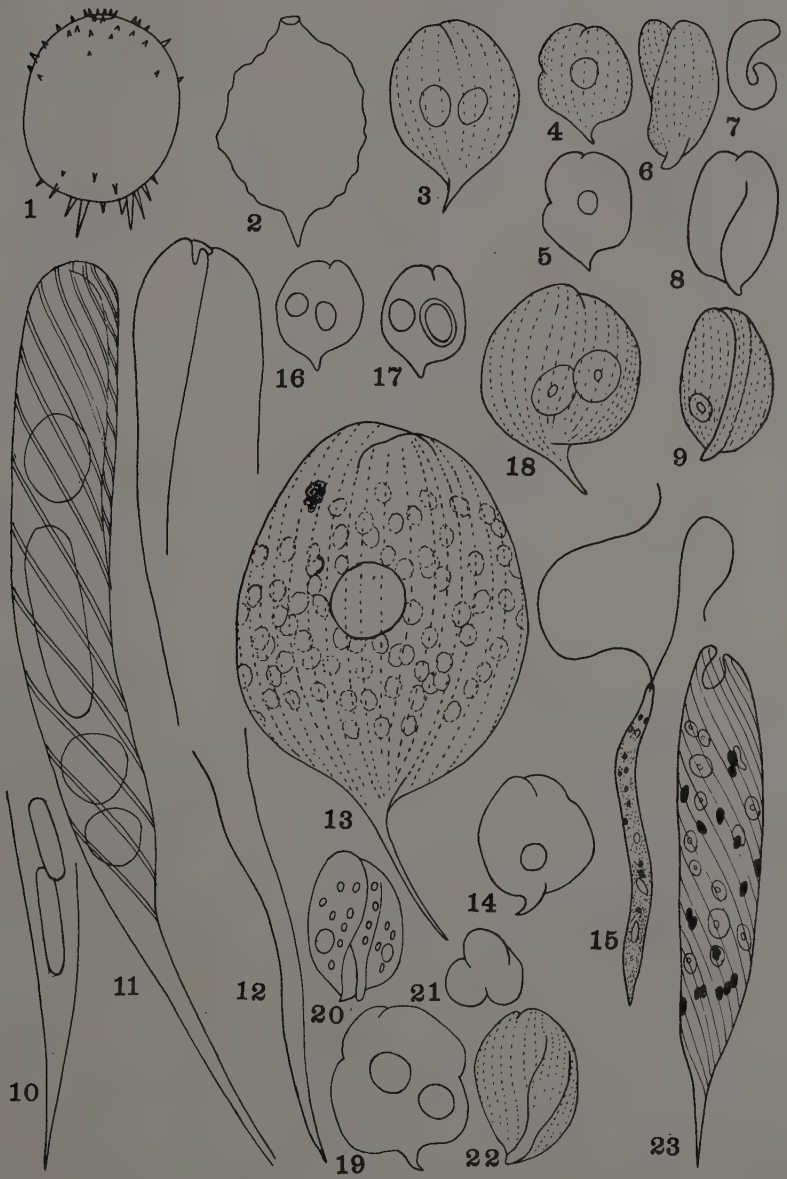
Cells broadly fusiform, somewhat abruptly narrowed anteriorly to a rounded, truncate apex, posteriorly gradually narrowed to a straight, colorless, sharply pointed caudus; pellicle spirally striated; chloroplasts several to many irregularly shaped platelets, containing a pyrenoid which is sheathed by a ring of paramylum bodies; flagellum $1\frac{1}{4}$ to $1\frac{1}{2}$ times the cell in length; pigment-spot large and conspicuous, (in ours showing two large granules); 13.6–17.5 μ in diameter, 47.6–78 μ long. Pl. 4, Fig. 15, 20, 21.

CZ–209; CZ–214. Rio Chilibres; Rio Chagres.

In the same collections containing *E. polymorpha* were found several *Euglena* cysts (Pl. 5, Fig. 1, 2) which in shape, however, are quite different from those described for this species.

EXPLANATION OF FIGURES IN PLATE III

1. *Trachelomonas superba* var. *Swirenkiana* Defl.
2. *Trachelomonas tambowika* Swir.
3. *Phacus brachykentron* var. *caudatus* var. nov.
4–5. *Phacus incisus* sp. nov.
6–9. *Phacus curvicauda* Swir.
10–12. *Euglena longicaudata* sp. nov.
13. *Phacus ranulus* sp. nov.
14. *Phacus undulatus* fa. minor fa. nov.
15. *Eutreptia elongata* sp. nov.
16–17. *Phacus acuminatus* Stokes.
18. *Phacus orbicularis* Hübner.
19 *Phacus undulatus* (Skv.) Poch.
20–22. *Phacus curvicauda* Swir. Fa.
23 *Euglena pseudoxyuris* sp. nov.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Euglena proxima Dangeard

Cells fusiform, spindle-shaped, gradually narrowed anteriorly to a bluntly rounded apex, and posteriorly to a sharp point (without a caudus); pellicle spirally striated; chloroplasts numerous ovoid discs or circular plates; paramylum bodies numerous, short rods or elongate-oval grains; flagellum about 1½ times the cell in length; 18.7–23 μ in diameter, 51–71 μ long. Pl. 4, Fig. 16.

CZ–208. Rio Chagres.

Euglena pseudoxyuris sp. nov.

Cells elongate-cylindric, broadly rounded at the anterior end, tapering gradually posteriorly, then sharply tapering to form a colorless, sharp caudus; periplast only very slightly metabolic, rigid, with fine, irregular spiral striations; chloroplasts few, scattered, irregular plates; paramylum grains forming discs about the pyrenoids; flagellum (?); 17 μ maximum diameter, 100 105.4 μ long. Pl. 3, Fig. 23.

CZ–87. Pond, U. S. Government Experimental Gardens.

This species should be compared with *E. oxyuris* Schmarda which has differently shaped paramylum grains and is larger.

Cellulae elongato-cylindricae, antice late rotundatae, postice sensim attenuatae, deinde, ad caudam acutam, sine colore, efficiendam, abrupte attenuatae; periplastus minime metabolicus, rigidus, striis tenuibus, irregulariter patelliformes; grana paramylacea discos circum pyrenoidea formantia; flagellum (?); 17 μ max. diam., 100–105.4 μ long.

Euglena spirogyra Ehr.

Cells elongate-cylindric but somewhat flattened when seen from the side, broadly truncate and rounded at the anterior end, posteriorly tapering rather abruptly to a stout, sharply pointed caudus; periplast spirally striated with rows of pointed granules; chloroplasts numerous, plate-like bodies scattered through the cell; paramylum in the form of 2 large circular links, one to either side of the central nucleus; flagellum short, about ¼ the cell in length; 21 μ in diameter, 136 μ long (usually not so long). Pl. 5, Fig. 12.

CZ–197. Rio Chagres.

Euglena subthinophila sp. nov.

Cells broadly fusiform to elongate, fusiform-cylindric in motion and when extended, broadly truncate at the anterior end or somewhat produced at the apex; posteriorly tapering to a bluntly rounded, colorless point; flagellum twice as long or 2½ times the length of the cell, attached in a shallow reservoir; pellicle apparently smooth; chloroplasts numerous platelets scattered throughout the cell; pyrenoids 2 (?), free from the chloroplasts, sheathed by rings of paramylum; 10.2 μ in diameter, 23.8 μ long. Pl. 4, Fig. 19.

CZ–209. Rio Chilibres.

This species should be compared with *E. thinophila* Skuja which it resembles somewhat in shape, but from which it differs in respect to pyrenoids, chloroplasts, and in flagellum length.

Cellulae late fusiformes ad elongato-fusiformi-cylindricas (dum movent dumque extensae iacent), in extremitate anteriore late truncatae aut in apice paululum productae; postice in acumen incoloratum, obtuse rotundatum attenuatae; flagellum 2 vel $2^1/_2$ plo longius quam

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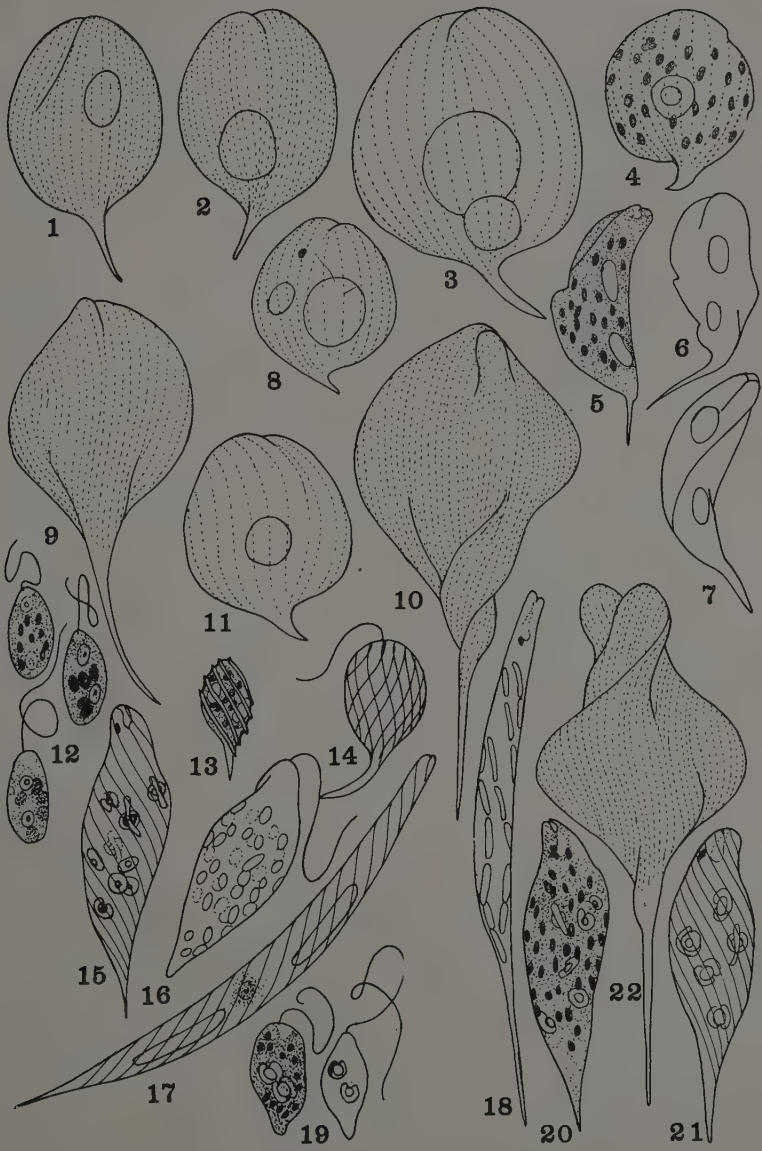
EXPLANATION OF FIGURES IN PLATE IV

1. *Phacus platalea* Drez.
2. *Phacus pleuronectes* (O. F. M.) Dui.
3. *Phacus triqueter* (Ehr.) Dui. Fa.
4. *Phacus pseudoswirenkoi* Presc. Fa.
5–7. *Phacus Raciborskii* Drez.
8. *Phacus Swirenkoi* Skv.
9. *Phacus tortus* (Lemm.) Skv.
10. *Phacus helikoides* Poch.
11. *Phacus orbicularis* Hübner
12. *Colacium vesiculosum* Ehr.
13. *Phacus pyrum* (Ehr.) Stein
14. *Lepocinclis ovata* Playf.
15. *Euglena polymorpha* Dang.
16. *Euglena proxima* Dang.
17–18. *Euglena acus* Ehr.
19. *Euglena subthinophila* sp. nov.
20-21. *Euglena polymorpha* Dang.
22. *Phacus helikoides* Poch.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longitudo cellulae, in fossa non alta affixum; pellicula ut videtur levis; chloroplasti lamellae numerosae per cellulam dispersae; pyrenoidea 2 (?), a chloroplastis seiuncta, per anulos paramyli vaginata; cellula 10.2 μ diam., 23.8 μ long.

Euglena velata Klebs

Cells broadly ellipsoid, or fusiform, rounded anteriorly, posteriorly tapering gradually to a blunt point; pellicle spirally and finely striated; chloroplasts numerous lobed and irregular plates containing a pyrenoid which has a sheath of paramylum, the paramylum also occurring as scattered, short, rod-like or oval bodies; flagellum nearly equal to the cell in length, 23.8 μ in diameter, 68.5 μ long. Pl. 5, Fig. 9, 10.

CZ–209. Rio Chilibres.

Phacus acuminatus Stokes Fa.

Cells angularly oval to sub-circular, broad in the basal part and narrowed abruptly to a short, sharply pointed caudus; pellicle longitudinally striated; chloroplasts numerous oval discs; paramylum 2 relatively large circular rings; flagellum about equal to the cell in length; 14 μ in diameter, 20.4 μ long. Pl. 3, Fig. 16, 17.

CZ–206. Rio Chagres.

This species seems to be similar to *P. acuminata* var. *Drezepolski* Skv. which Pochmann, (1942) has transferred to *P. caudatus* Hüb. Our specimens cannot be assigned to the latter, however.

Phacus brachykentron var. **caudatus** var. nov.

Cells oval or elliptic, broadly rounded anteriorly, narrowed abruptly posteriorly to form a sharp, slightly curved caudus; pellicle apparently smooth (striae invisible); paramylum 2 medium-sized rings; 28.8 μ in diameter, 40.8 μ long. Pl. 3, Fig. 3.

CZ–84. Pond in U. S. Government Experimental Gardens.

This variety differs from the typical by its somewhat larger size, the longer caudus and the (apparently) smooth pellicle.

Cellulae ovatae ellipticaeve, antice late rotundatae, postice, ad caudam acutam, paululum curvatum efficiendam, abrupte attenuatae; membrana, ut videtur, levis (striis invisibilibus); corpora paramylacea duo, mediocria, anuliformia; cellulae 28.8 μ diam., 40.8 μ long.

Phacus curvicauda Swir. Fa.

Cells broadly oval to nearly circular in outline, broadest at or below the midregion, tapering posteriorly abruptly to form a short, curved or deflected tail-piece; body with a flange on both the dorsal and ventral surfaces so that in cross section the cell is 2- or 3-lobed (apparently varying in this respect); pellicle longitudinally striate; chloroplasts numerous, scattered oval bodies; paramylum 2 large circular plates; 17.0 μ in diameter, 28.9 μ long. Pl. 3, Fig. 6–9; 20–22.

CZ–206. Rio Chagres.

Phacus helikoides Pochmann

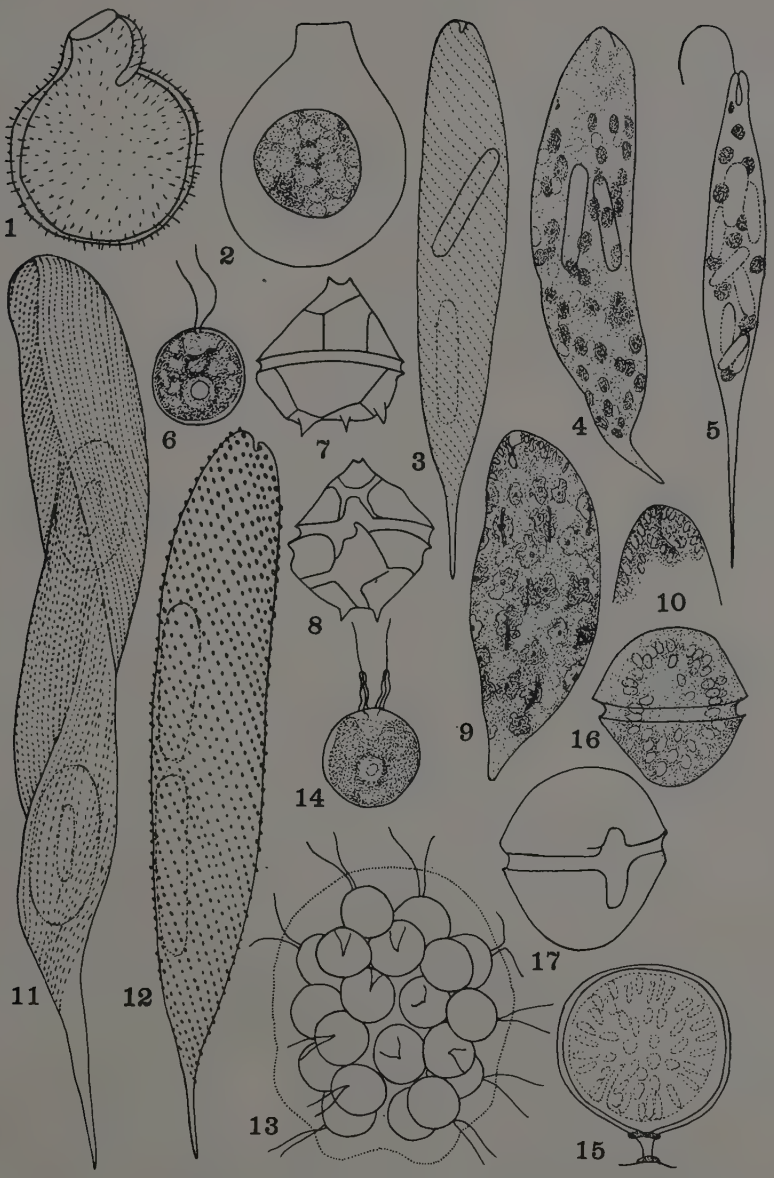
Cells pyriform, spirally twisted, bilobed anteriorly, broadest in the median region and then tapering and twisted into a long, straight caudus posteriorly; pellicle spirally striated longitudinally; 1 medianly placed paramylum plate; 40.8 μ in diameter, 105.4 μ long. Pl. 4, Fig. 22.

CZ–206. Rio Chagres.

This species has passed under the name of *P. tortus* var. *tortuosa* Skv.

EXPLANATION OF FIGURES IN PLATE V

1–2. *Euglena cysts.*
3–4. *Euglena intermedia* (Klebs) Schmitz.
5. *Euglena acus* Ehr.
6. *Chlamydomonas incerta* Pascher.
7–8. *Glenodinium quadridens* (Stein) Schiller.
9–10. *Euglena velata* Klebs.
11. *Euglena oxyuris* Schmar.
12. *Euglena Spirogyra* Ehr.
13–14. *Eudorina unicocca* G. M. Smith
15. *Stylodinium globosum* Klebs
16–17. *Glenodinium pulviseulus* (Ehr.) Stein.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Phacus incisus sp. nov.

Cells broadly rounded and slightly bilobed anteriorly, narrowed abruptly posteriorly into a short caudus which curves to the right; a sharp notch on the left margin of the cell; wall finely striated longitudinally; 1 large paramylum ring, medianly located; 18–19 μ in diameter, 23.8–25 μ long. Pl. 3, Fig. 4–5.

CZ–206. Rio Chagres.

This species should be compared with *P. undulatus* (Skv.) Pochmann which is larger and which has invaginations on both lateral margins; has two large paramylum grains.

Cellulae ovatae, antice paululum bilobatae atque late rotundatae, postice in caudam brevem, dextrorsum curvatum, abrupte attenuatae; margo sinister cellulae incisura acuta praeditus; membrana tenuiter, longitudinaliterque striata; corpus paramylaceum magnum, anuliforme, media in parte dispositus; cellulae 18–19 μ diam., 23.8–25 μ long.

Phacus orbicularis Hübner Fá.

Cells broadly ovate to suborbicular, broadly rounded anteriorly, posteriorly narrowed abruptly to a relatively long, sharp and curved or deflected caudus; pellicle longitudinally striated; paramylum bodies in the form of 2 large circular plates, 30.6–34 μ in diameter, 40.8 μ long. Pl. 3, Fig. 18; Pl. 4, Fig. 11.

CZ–84; CZ–86; CZ–94. Pond, U. S. Government Experimental Gardens; Rio Chagres.

Phacus platalea Drez.

Cells broadly oval, rounded anteriorly, posteriorly slightly spirally twisted and tapered to a curved, long and sharp caudus; flattened or concave on the ventral surface, convex dorsally; pellicle longitudinally striated; chloroplasts numerous circular plates; 1 large paramylum plate; 30.6 μ in diameter, 51 μ long. Pl. 4, Fig. 1.

CZ–206. Rio Chagres.

Phacus pleuronectes (O. F. M.) Duj. Fa.

Cells unsymmetrically oval or nearly orbicular, bilobed at the apex, slightly spiral posteriorly and tapered abruptly to a deflected, sharp caudus; pellicle longitudinally striated; paramylum grains 1 or 2 large circular plates; 30 μ in diameter, 47 μ long. Pl. 4, Fig. 2.

CZ–193. Rio Chilibres.

This species should be compared with *P. platalea* which is more elongate and more nearly symmetrical in shape.

Phacus pseudoswirenkoi Presc. Fa.

Cells orbicular, broadly rounded anteriorly, abruptly narrowed posteriorly to form a strongly deflected, sharp caudus; margin with one or two sharp notches on the right side; pellicle longitudinally striated; chloroplasts numerous oval bodies; 1 large circular paramylum plate; 30 μ in diameter, 37.4 μ long. Pl. 4, Fig. 4.

CZ–142. Pond near Frijoles, C. Z.

Phacus pyrum (Ehr.) Stein

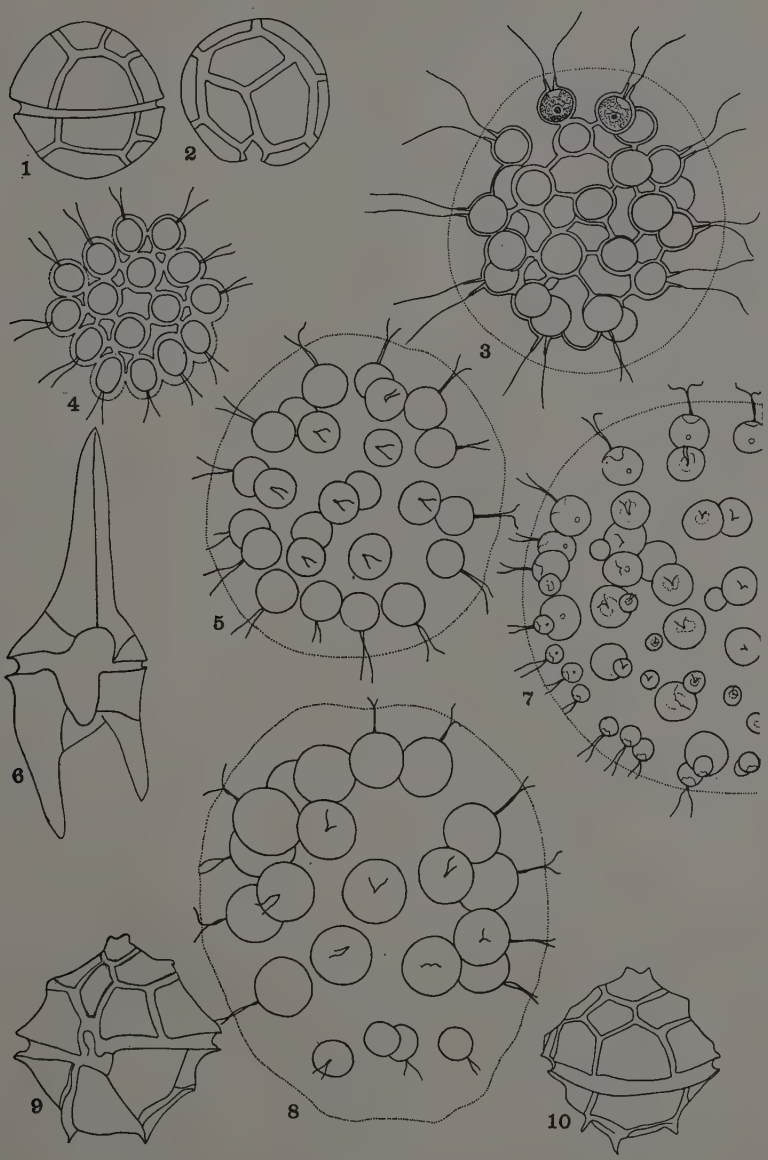
Cells small, broadly oval, narrowed posteriorly to a sharp, pointed and straight caudus; pellicle coarsely striated spirally; paramylum bodies 2 lateral discs (one on either side); flagellum about $\frac{2}{3}$ of the cell in length; 10 μ in diameter, 25.5 μ long. Pl. 4, Fig. 13.

CZ–206. Rio Chagres.

This species is questionably assigned to *P. pyrum*, but should be compared with *P. atraktoides* Poch., a synonym for a form of *P. pyrum* noted by Skvortzow (1937).

EXPLANATION OF FIGURES IN PLATE VI

1–2. *Gonyaulax palustre* Lemm.
3. *Eudorina interconnexa* sp. nov.
4. *Gonium pectorale* Müll.
5. *Eudorina elegans* Ehr.
6. *Ceratium hirundinella* (O. F. M.) Dui.
7. *Pleodorina californica* Shaw.
8. *Pleodorina illinoisensis* Kofoid.
9–10. *Peridinium bipes* Stein.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Phacus raciborskii Drez.

Cells unsymmetrically elliptical or pyriform, tapered posteriorly to form a curved and deflected caudus; dorsal surface with a flange so that the cell is irregularly 'V'-shaped in cross section; pellicle smooth or faintly striated longitudinally; lateral margin with a notch or emargination when seen from the 'front' (in ours); 13–16 μ in diameter, 44 μ long, including the caudus. Pl. 4, Fig. 5–7.

CZ–206. Rio Chagres.

Phacus ranulus sp. nov.

Cells broadly ovoid, broadly rounded anteriorly and with a fold near the gullet; narrowed posteriorly to a long, tapering, curved caudus; pellicle longitudinally striated; 1 large, median paramylum plate; 54.4 μ in diameter, 95.2 μ long. Pl. 3, Fig. 13.

CZ–206. Rio Chagres.

This species should be compared with *P. gigas* Da Cunha which is more nearly orbicular and has many small paramylum grains.

Cellulae ovatae, late rotundatae, plicamque prope gulam habentes, postice ad caudam longam, fastigatam, curvatam attenuatae; periplastus longitudinaliter striatus, corpus paramylaceum unicum, magnum, medium anuliforme; cellulae 54.5 μ diam., 95.2 μ long.

Phacus Swirenkoi Skvortzow

Cells broadly oval or suborbicular, unsymmetrically tapered posteriorly and twisted to form a short, sharply deflected caudus; with a dorsal flange so that the cell is irregularly triangular in end view; pellicle longitudinally striated; paramylum bodies 1 or 2 medium-sized plates; 27.2-30.6 μ in diameter, 34 μ long. Pl. 4, Fig. 8.

CZ–215; CZ–193. Rio Chagres; Rio Chilibres.

Phacus tortus (Lemm.) Skvortzow

Cells pyriform in the body but spirally twisted and tapering to a long straight caudus posteriorly; bilobed at the apex; pellicle longitudinally striated; paramylum grains variable, usually one very large, median, circular plate; 40–48 μ in diameter, 95–100 μ long. Pl. 4, Fig. 9.

CZ–142. Pond near Frijoles, C. Z.

Phacus triqueter (Ehr.) Duj. Fa.

Cells broadly ovate, the margins unsymmetrically convex, with a flange on the dorsal surface so that the cell is triangular in cross section; tapered posteriorly to a relatively long, curved, sharp caudus; pellicle longitudinally striated; chloroplasts numerous circular plates; 2 large paramylum rings; 47.6 μ in diamter, 68 μ long. Pl. 4, Fig. 3.

CZ–79. Pond, U. S. Government Experimental Gardens.

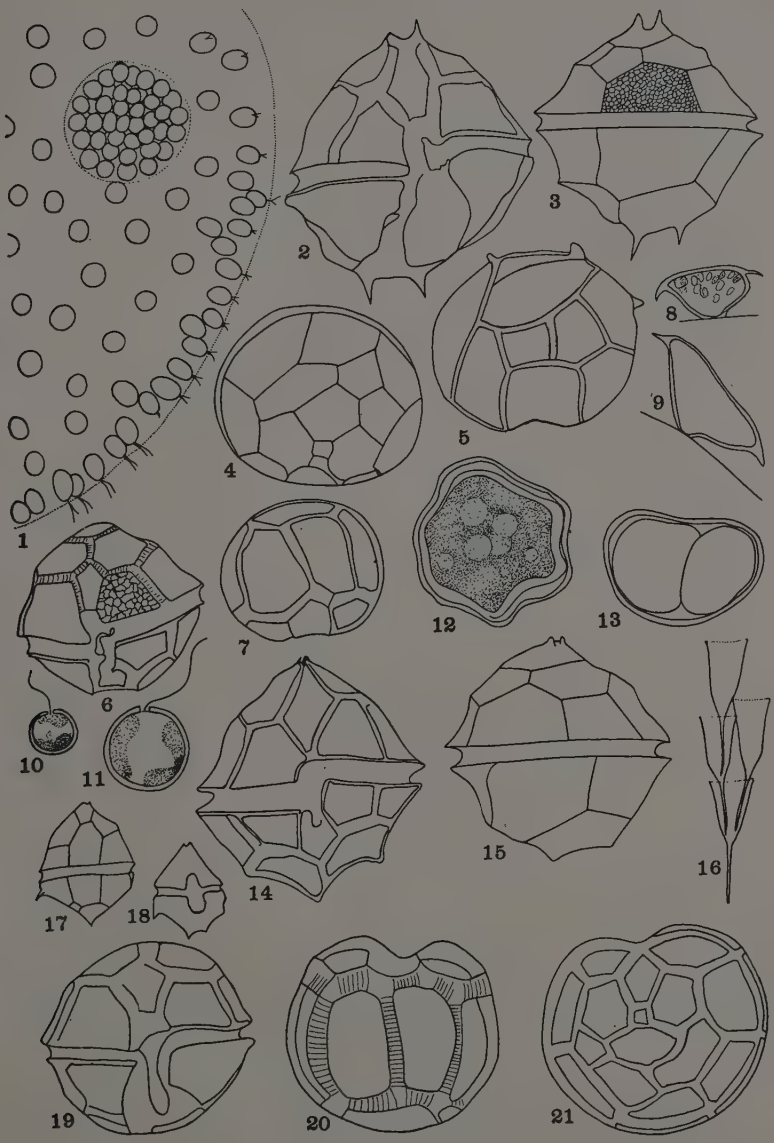
Phacus undulatus (Skv.) Pochmann

Cells broadly oval, broadly rounded anteriorly, broadest in the basal region which is abruptly narrowed to form a short, bluntly pointed caudus; lateral margins of the cell incised or emarginate to form undulations; pellicle finely striated longitudinally; chloroplasts numerous scattered circular bodies; paramylum in the form of 2 circular plates, one often much larger than the other; 27.2 μ in diameter, 34 μ long. Pl. 3, Fig. 19.

CZ–86. Pond, U. S. Government Experimental Gardens.

EXPLANATION OF FIGURES IN PLATE VII

1. *Volvox aureus* Ehr.
2–5. *Peridinium bipes* Stein.
6–7. *Peridinium galunense* Ostenfeld & Nygaard.
8–9. *Raciborski bicornis* Wolosz.
10–11. *Chrysococcus rufescens* Klebs.
12–13. *Dinoflagellate cysts.*
14–15. *Peridinium Gutwinskii* Wolosz.
16. *Proteriodendron petiolatum* var. *Abbottii* (Stokes) Playf.
17–18. *Peridinium inconspicuum* Lemm.
19. *Peridinium Volzii* Lemm.
20–21. *Peridinium Gutwinskii* Wolosz.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Phacus undulatus fa. **minus** fa. nov.

Cells broadly ovoid, with a short, deflected tail-piece; margin with a shallow notch or invagination on either side near the anterior end; pellicle scarcely if at all striated; paramylum body a single, circular plate; 23.8 μ in diameter, 27.2 μ long. Pl. 3, Fig. 14.

CZ–142. Pond near Frijoles, C. Z.

Cellulae latae ovatae, caudam brevem, deflectam, et marginem incisura vadosa vel invaginatione utrinque prope extremitatem anteriorem haventes; membrana vix aut haud striata; corpus paramylaceum unicum; cellulae 23.8 μ lat., 27.2 μ long.

Lepocinclis ovata (Playf.) Conrad

Cells oval or ovate-pyriform, broadly rounded anteriorly, rather abruptly tapered posteriorly to form a long straight or curved caudus; pellicle coarsely striated with spiral lines; 2 paramylum rings, one on either side of the cell; 17 μ in diameter, 34 μ long. Pl. 4, Fig. 14.

CZ–208. Rio Chagres.

Trachelomonas armata var. **longispina** Playf., emend. Deflandre

Test broadly oval or subpyriform (slightly narrowed at the anterior end); wall unevenly beset with sharp, slender spines (variable in number and disposition) but with basal spines much longer, stouter and all directed posteriorly; 38–40 μ in diameter, 38–51 μ long (including spines). Pl. 2, Fig. 7, 12, 13.

Trachelomonas armata var. **ovata** Swir.

Test broadly oval or ovate, with a slight thickening about the flagellum aperture; wall beset with sharp spines in the anterior region, smooth in the main body, but with a number of stout posteriorly projecting spines in the basal region; 31 μ in diameter, 37.4 μ long. Pl. 2, Fig. 14.

CZ–142. Pond near Frijoles, C. Z.

Trachelomonas armata var. **oavta** fa. **truncata** fa. nov.

Test pyriform, broadly truncate at the anterior end, enlarged and broadly rounded posteriorly; posterior spines 6–8 μ long and hooked, the wall almost evenly beset with shorter, straight spines which are all about the same length; 34 μ in diameter, 51 μ long. Pl. 2, Fig. 11.

CZ–84. Pond, U. S. Government Experimental Gardens.

Test pyriformis, antice late truncata, postice amplificata et late rotundata; spinae posteriores 6–8 μ long., uncinatae, membrana spinis brevioribus, rectis, satis aequilongis fere aequaliter obsita; cellula 34 μ lat., 51 μ long.

Trachelomonas armata fa. **paucispina** fa. nov.

Test pyriform, narrow anteriorly and broadly rounded to somewhat truncate; 2 or 3 short, stout, irregularly placed spines at the posterior pole; posterior and anterior regions sparsely beset with very short, sharp spines, a ring of spines about the flagellum aperture; 32.3 μ in diameter, 40.8 μ long. Pl. 2, Fig. 9.

CZ–196. *Salvinia* beds, Rio Chagres.

Testa pyriformis, antice angusta atque late rotundata ad satis truncatam; spinae crassae ad polam posteriorem irregulariter dispositae; pars posterior atque pars anterior spinis brevissimis, acutis, sparse obsitae, anulo spinarum circum aperturam flagelli ordinato; cellula 32.3 μ diam., 40.8 μ long.

Trachelomonas armata var. **Steinii** Lemm.

Test broadly oval to nearly spherical; spines relatively short and often blunt, mostly occurring in the anterior and posterior regions, the midregion almost smooth; 28.9–29.6 μ in diameter, 34–35 μ long. Pl. 2, Fig. 6.

CZ–84; CZ 139; P 11. Pond, U. S. Government Experimental Gardens; ditch near R. R. track, Frijoles, C. Z.

Trachelomonas cylindrica Ehr.

Test short-cylindric, the lateral margins parallel, the poles symmetrically rounded; flagellum aperture with a smooth collar; wall smooth and colorless or light brown, 10.5 μ in diameter, 16.7 μ long. Pl. 1, Fig. 16.

CZ–214. Plankton in Rio Chagres, Juan Mina.

Trachelomonas cylindrica var. **decollata** Playf.

Test elongate-cylindric, the anterior end somewhat truncate, the posterior pole narrowly rounded; flagellum aperture with a slight thickening; wall smooth, colorless or light yellow; 6.8 μ in diameter, 17 μ long. Pl. 1, Fig. 2, 3.

Trachelomonas Dybowskii Drez.

Test broadly oval; wall smooth; flagellum aperture with a thickening but without a distinct collar; 20.4–23.8 μ in diameter, 23–25 μ long. Pl. 1, Fig. 10.

CZ–196; CZ–82. Pond, U. S. Government Experimental Gardens; *Salvinia* beds, Rio Chagres.

A form nearly spherical (Pl. 1, Fig. 11) was found in the plankton of Gatun Lake.

Trachelomonas ensifera Daday

Test broadly fusiform, somewhat abruptly produced anteriorly to form a long neck and abruptly narrowed posteriorly to form a long sharply pointed caudus, some cells transversely oval in the body; mouth of the flagellum aperture beset with teeth-like projections (sometimes absent); wall smooth, colorless or light yellow; 37–44 μ in diameter, 85–102 μ long. Pl. 2, Fig. 1.

CZ–196; CZ–206. *Salvinia* beds, Rio Chagres, Juan Mina.

Trachelomonas ensifera fa. **dentifera** fa. nov.

A form not so broadly fusiform, oval, gradually narrowed above to a long neck with a ring of prominent teeth about the flagellum aperture; more abruptly narrowed posteriorly to a long, straight, spine-like extension; test colorless to light brown, smooth; 37–39 μ in diameter, 85–88 μ long. Pl. 1, Fig. 1.

CZ–196. *Salvinia* beds, Rio Chagres, Juan Mina.

Testa ovato-fusiformis, superne ad collum longum sensim attenuata, collum anulo dentium prominentium circum aperturam flagelli praeditum; postice ad extensionem longam, rectam, spiniformen abruptius attenuata; testa sine colore ad pallide brunneam, levis; cellula 37–39 μ diam., 85–88 μ long.

Trachelomonas fluviatile var. **curvata** Lemm.

Test broadly oval, briefly produced anteriorly to form a neck, and abruptly narrowed posteriorly to form a long, straight caudus; wall smooth; 29.6 μ in diameter, 74 μ long. Pl. 1, Fig. 22.

CZ–160. Pond near R. R., Gatun, C. Z.

Trachelomonas fluviatilis var. **curvicauda** var. nov.

Test broadly oval with a short, relatively wide neck; abruptly narrowed posteriorly to a short, sharp and strongly deflected caudus; 22 μ in diameter, 39 μ long. Pl. 1, Fig. 12.

CZ–68. Plankton, Rio Coccoli.

Testa late ovata, collo brevi atque relative lato; postice ad caudam brevem, acutam, valdeque deflectam, abrupte attenuata; cellula 22 μ diam., 39 μ long.

Trachelomonas fluviatilis var. **rugosa** var. nov.

Test asymmetrically oval, somewhat gradually narrowed above to a short, wide neck, and posteriorly more abruptly tapered to a straight, pointed caudus; wall light brown and distinctly rugose; 23.8–30.6 μ in diameter. 64–68 μ long. Pl. 1, Fig. 25, 26.

CZ–196. *Salvinia* beds, Rio Chagres, Juan Mina.

Testa asymmetrice ovata, antice ad collum breve. latum quasi sensim attenuata, postice ad caudam rectam, acuminatam abruptius attenuata; membrana pallide brunnea, perspicue rugosa; cellula 23.8–30.6 μ diam., 64–68 μ long. cum cauda.

Trachelomonas hispida (Perty) Stein Fa.

Test broadly oval; the wall evenly beset with numerous short, sharp spines; flagellum aperture with a slight thickening which is smooth; 27.2 μ in diameter, 35 μ long. Pl. 1, Fig. 18.

CZ–134. Pond near R. R., Frijoles, C. Z.

Trachelomonas hispida var. **coronata** Lemm.

Test ovoid, evenly beset with fine spines; flagellum aperture with a short collar with a fringe of short spines; 22.1 μ in diameter, 35 μ long. Pl. 1, Fig. 23.

CZ–196. *Salvinia* beds, Rio Chagres, Juan Mina.

Trachelomonas hispida var. **duplex** Playf.

Test broadly oval; anterior and posterior regions with short, sharp spines, median region smooth; flagellum aperture without a collar; 23.8 μ in diameter, 37.8 μ long. Pl. 2, Fig. 8.

CZ–44. Gigante Bay, Gatun Lake.

Trachelomonas hispida var. **papillata** var. nov.

Test broadly ovoid, beset with short papillate spines; flagellum aperture a smooth opening; wall yellowish; 17 μ in diameter, 23.8 μ long. Pl. 1, Fig. 19, 29.

CZ–215. Rio Chagres, Juan Mina.

Testa late ovata, subflava, spinis brevibus, papillatis sparse obsita; apertura flagelli levis, circularis; cellula 17 μ diam., 23.8 μ long.

Trachelomonas hispida var. **punctata** Lemm.

Test oval; wall densely punctate and slightly roughened but otherwise smooth; flagellum aperture with a slight thickening; 18.2 μ in diameter, 27.2 μ long. Pl. 1, Fig. 15.

CZ–101. *Utricularia* bed, Rio Chagres.

Trachelomonas intermedia Dang.

Test ovoid; wall finely punctate, yellowish-brown; flagellum aperture with a smooth thickening; 17 μ in diameter, 20.4 μ long. Pl. 1, Fig. 13.

CZ–215. Rio Chagres, Juan Mina.

Trachelomonas Kelloggii var. **punctata** Skv.

Test broadly ovoid; wall densely and coarsely punctuate, yellow-brown; flagellum aperture with a thickened, smooth ring; 23.5 μ in diameter, 28.9 μ long. Pl. 1, Fig. 9.

CZ–197. Rio Chagres, Juan Mina.

Trachelomonas Lefevrei var. **levis** var. nov.

Test broadly oval or oval-ellipsoid, with a short collar around a relatively wide flagellum aperture; wall smooth, colorless; 30.6 μ in diameter, 40.8 μ long. Pl. 2, Fig. 5.

CZ–79. Pond, U. S. Government Experimental Gardens.

Testa late ovata ovato-ellipsoidea, collari brevi circum flagelli aperturam relative latam praedita; membrana levis, sine colore; cellula 30.6 μ diam., 40.8 μ long.

Trachelomonas Manginii Defl.

Test oval, sometimes slightly narrowed posteriorly; flagellum aperture with a short, smooth collar; wall almost colorless, smooth; 18.7 μ in diameter, 23.8 μ long. Pl. 1, Fig. 4.

CZ–206. Juan Mina, Rio Chagres.

Trachelomonas napiformis sp. nov.

Test smooth, vasiform, napiform with a long, stout, straight caudus tapering from a broad basal portion; anteriorly tapering gradually into a long neck with sides slightly undulate and ending in a flagellum aperture which has a toothed rim; test with (2)–3 transverse ring-like swellings just above the broader region of the cell; 40–42 μ in diameter, 105–110 μ long. Pl. 1, Fig. 27–28.

CZ–196. *Salvinia* beds, Rio Chagres.

Testa levis, vasiformi-napiformis, cauda longa, crassa, recta, a parte basali lata attenuata praedita; antice in collum longum, lateribus subundulatis, sensim attenuata, et ad aperturam flagelli, ora dentata praeditam, terminata; test (2)–3 inflationibus transversis, anuliformibus admodum super partem latam praedita; cellula 40–42 μ diam., 105–110 μ long.

Trachelomonas oblonga Lemm.

Test broadly or narrowly oval, symmetrically rounded at both poles; flagellum aperture with a slight internal thickening (in ours); wall smooth, brown; 13.6 μ in diameter, 16.5 μ long. Pl. 1, Fig. 5.

CZ–142. Pond near Frijoles, C. Z.

Trachelomonas oblonga var. **attenuata** Playf.

Test oval, somewhat truncate at the anterior end; flagellum aperture with a low, smooth collar; wall smooth, pinkish-brown; 9.8 μ in diameter, 13.6 μ long. Pl. 1, Fig. 6, 7.

CZ–206. Juan Mina, Rio Chagres.

Trachelomonas pisciformis sp. nov.

Test broadly ovoid, tapering abruptly posteriorly to form a long caudus with subparallel, smooth margins, ending in 2 stout spines or bifurcations; anteriorly briefly tapering to form a short neck in which the flagellum aperture is located, with 4 stout diverging spines at its rim; test sparsely beset with both long and stout, short spines; 17.5 μ in diameter without spines, 27 μ in diameter including spines; 54.4 μ long including spines. Pl. 1, Fig. 20.

CZ–214. Juan Mina, Rio Chagres.

Testa late ovata, postice ad caudam longam marginibus subparallelibus levibusque efficiendam, abrupte attenuata, cauda in 2 spinas crassas aut bifurcationes terminate; antice ad collum breve efficiendum breviter attenuata, collum habens aperturam flagelli, ad oram 4 spinas crassis divergentibusque praeditam; testa spinis longis crassisque, brevibus acutisque sparse obsita; cellula 17.5 μ diam. sine spinis, 27 μ cum spinis, 54.4 μ long. cum spinis.

Trachelomonas pulcherrima var. **elevatum** var. nov.

Test oblong-ovate to nearly cylindric, truncate and depressed at the anterior end, with sharp lateral shoulders; flagellum aperture in a short smooth collar; wall smooth, light brown; 7 μ in diameter, 16.8 μ long. Pl. 1, Fig. 30, 31.

CZ–206. Juan Mina, Rio Chagres.

Testa oblong-ovata ad subcylindricam, in extremitate anteriore, humeris lateralibus acutis, truncata depressaque; apertura flagelli intra collare breve leveque; membrana levis, dilute brunnea; cellula 7 μ diam., 16.8 μ long.

Trachelomonas pulcherrima var. **latior** fa. **collarita** fa. nov.

Test narrowly ovoid; wall smooth; flagellum aperture with a low collar; 10.2 μ in diameter, 20.4 μ long. Pl. 1, Fig. 24.

CZ–197. Juan Mina, Rio Chagres.

Testa anguste ovata, levis; apertura flagelli collari humili praedita; cellula 10.2 μ diam., 20.4 μ long.

Trachelomonas scabra var. **longicollis** Playf.

Test oval to subcyclindric; wall rugose and coarsely lumpy; flagellum aperture in a short deflected neck with a smooth rim; 17 μ in diameter, 27.2 μ long. Pl. 1, Fig. 8.

CZ–206. Juan Mina, Rio Chagres.

Trachelomonas speciosa var. **spinosa** var. nov.

Test fusiform, tapering posteriorly to a stout caudus which bears 3 long, stout furcations and anteriorly to a broad flagellum opening with 4 (or 5) stout spines at the margin; surface of test sparsely beset with stout spines; 23.8 μ in diameter, 51 μ long. Pl. 1, Fig. 17.

CZ–197. Juan Mina, Rio Chagres.

Testa fusiformis, postice ad caudam crassam, 3 furcationes longas crassasque ferentem, attenuata; antice ad aperturam flagelli latam, in margine 4 (vel 5) spinis crassis praeditam, attenuata; superficies testae spinis crassis praeditam, attenuata; superficies testae spinis crassis sparsim obsita; cellula 23.8 μ diam., 51 μ long.

Trachelomonas similis Stokes

Test broadly ovoid, roughened irregularly, produced anteriorly into a short, curved collar with a smooth but oblique margin; 13.6 μ in diameter, 23.8 μ long. Pl. 2, Fig. 4.

CZ–197. Juan Mina, Rio Chagres.

Trachelomonas spectabilis Defl.

Test oval, poles symmetrically rounded; wall brown, rather evenly beset with long stout spines; flagellum aperture with a rim of short spines; 51 μ in diameter, 65-68 μ long with spines. Pl. 2, Fig. 2.

CZ–87; CZ–206. Pond, U. S. Government Experimental Gardens; Juan Mina, Rio Chagres.

Trachelomonas subflava sp. nov.

Test ovoid, light straw-colored; wall coarsely punctate, sparsely beset with fine, sharp spines which are slightly longer in the posterior part of the test; flagellum aperture in a short collar which has diverging lateral margins and a smooth rim; 23.8 μ in diamterer, 35.7 μ long. Pl. 1, Fig. 21.

CZ–215. Rio Chagres.

Testa ovata, pallide straminea colore, crasse punctata, spinis tenuibus acutis, parte in posteriore paulo longioribus, sparse obsita apertura flagelli collare breve, marginibus lateralibus divergentibus oraque levi praeditum, habens; cellula 23.8 μ diam., 35.7 μ long.

Trachelomonas superba Swir. Fa.

Test broadly oval; wall brown with a few scattered, short spines and with more densely arranged spines near the posterior pole; flagellum aperture with a low collar that has a smooth margin; 30.6 μ in diameter, 40.8 μ long. Pl. 2, Fig. 3.

CZ–196. *Salvinia* beds, Rio Chagres.

Trachelomonas superba var. **Swirenkiana** Defl.

Test broadly oval; wall brown, beset with spines near the anterior and posterior poles, those in the posterior region being distinctly longer; flagellum aperture without a rim or collar but with the margin beset with a ring of small spines; 27.2 μ in diameter, 42.5 μ long. Pl. 3, Fig. 1.

CZ–211. Rio Chagres.

Trachelomonas tambowika Swir.

Test fusiform, abruptly narrowed anteriorly to form a short, relatively wide neck and flagellum aperture, and likewise tapered posteriorly to form a short, stout caudus; wall light brown or tan to nearly colorless, irregularly corrugated and crinkled; 30.6 μ in diameter, 44 μ long. Pl. 3, Fig. 2.

CZ–142. Pond near R. R., Frijoles, C. Z.

Trachelomonas volvocina Ehr.

Test globular or nearly so; wall light brown or yellowish, smooth (some forms punctate); flagellum opening a smooth circle, sometimes with a slight marginal swelling; 17 μ in diameter, 18-20.4 μ long. Pl. 1, Fig. 14.

CZ–84. Pond, U. S. Government Experimental Gardens.

Trachelomonas Wermelii Skv.

Test globular; wall brown, rather thick and conspicuously punctate; flagellum aperture in a high collar with parallel lateral margins; 27.2 μ in diameter, 27.2 μ long. Pl. 2, Fig. 15.

CZ–206. Juan Mina, Rio Chagres.

Trachelomonas Wermelii var. **paludosa** Skv. Fa.

Smaller than the typical, wall brown and smooth; 13.6 μ in diameter, 15.5 μ long. Pl. 2, Fig. 16.

CZ–84. Pond, U. S. Government Experimental Gardens.

Colacium vesiculosum Ehr.

Cell ovate-fusiform, changing shape in motion, becoming attached anterior end downward, forming a gelatinous attaching stalk and forming branched colonies through cell division; chloroplasts several to many ovoid plates; pyrenoids with a sheath of paramylum (usually 2 showing in each cell); pigment spot anterior and lateral; flagellum about as long as the cell; 8.5–10 μ in diameter, 18.7 μ long. Pl. 4, Fig. 12.

CZ–209. Rio Chilibres.

This organism is usually found attached to microcrustacea and other small animals; forming plume-like or gregarious colonies; seldom is found swimming free.

Eutreptia elongata sp. nov.

Cells elongate, fusiform-cylindric, narrowed gradually anteriorly to a bilobed apex, posteriorly rather abruptly tapering to a sharp point; chloroplasts few, disc-shaped; paramylum 3 to several small scattered rods; flagella 2, $\frac{2}{3}$ to $\frac{3}{4}$ the length of the cell; 5.1 μ in diameter, 61 μ long. Pl. 3, Fig. 15.

CZ–206. Juan Mina, Rio Chagres.

Cellulae elongatae, fusiformi-cylindricae, antice ad apicem bilobatum sensim attenuatae, postice ad acumen abruptis attenuatae; chloroplasti pauci, disciformes; bacilli paramylaceparvi 3 vel plures, sparsi; flagella $\frac{2}{3}$ ad $\frac{3}{4}$ cellulae longitudinis; cellulae 5.1 μ diam., 61 μ long.

PYRRHOPHTYA

Glenodinium pulvisculus (Ehr.) Stein

Cell globular, 30.6 μ in diameter, 30.6 μ long. Pl. 5, Fig. 16, 17.

CZ–196. *Salvinia* beds, Rio Chagres.

Glenodinium quadridens (Stein) Schiller

Cells ovate, epitheca cone-shaped; 31 μ in diameter, 44.4 μ long. Pl. 5, Fig. 7, 8.

CZ–18; CZ–41. Madden Lake; Gigante Bay, Gatun Lake.

Peridinium bipes Stein

Cells nearly globular in 'front' view, slightly compressed when seen from the side; 61 μ in diameter, 68 μ long. Pl. 6, Fig. 9, 10.

CZ–4; CZ–34; CZ–48. Gigante Bay and Laboratory Bay, Gatun Lake.

Peridinium gatunense Ostenfeld & Nygaard

Cells nearly globular; 47.6 μ in diameter, 44.2 μ long. Pl. 7, Fig. 6, 7.

CZ–38; CZ–48. Gigante Bay, Gatun Lake.

Peridinium Gutwinski Wolosz.

Cells globular; 57 μ in diameter, 61.2 μ long. Pl. 7, Fig. 14, 15; 20, 21.

CZ–40; CZ–55; CZ–104. Plankton, Gatun Lake; Gigante Bay.

Peridinium inconspicuum Lemm.

Cells fusiform, small, the plates faintly discernible; 18.5 μ in diameter, 25.9 μ long. Pl. 7, Fig. 17, 18.

Pan–11. Pond near Frijoles, C. Z.

Peridinium Volzii Lemm.

Cells nearly globular, both poles symmetrically rounded; 63 μ in diameter. Pl. 7, Fig. 19.

Pan–34. Gigante Bay, Gatun Lake.

Gonyaulax palustre Lemm.

Cells globular; both poles symmetrically rounded, round in lateral view; 40.7 μ in diameter. Pl. 6, Fig. 1, 2.

Pan–11. Pond near Frijoles, C. Z.

Ceratium hirundinella (O. F. M.) Duj.

Cells fusiform; anterior end tapering to form a long horn; posteriorly with 2 or 3 horns (in ours with 2 horns only); 60–80 μ in diameter, 150–200 μ long. Pl. 6, Fig. 6.

Pan–2: CZ–142. Plankton, Gatun Lake; Pond near Frijoles, C. Z.

Raciborskia bicornis Wolosz.

Cells triangular in 'front' view, attached by a narrow base, the free angles bearing a curved spine; 9–12 μ in diameter, 25 μ long including spines. Pl. 7, Fig. 8, 9.

CZ–85. U. S. Government Experimental Gardens.

Stylodinium globosum Klebs

Cells globular, on an attaching stipe with a thickened plug at the base of the cell proper; chloroplast brownish-green, parietal, cells 31 μ in diameter. Pl. 5, Fig. 15.

CZ–134. Pond near Frijoles, C. Z.

CHRYSOPHYTA

Chrysococcus rufescens Klebs

Cells globular; shell brown with a minute flagellar opening; chromatophores 2 or 3 faintly pigmented bodies; flagellum about equal to the diameter of the cell; leucosin (?) bodies conspicuous; cells 4–8 μ in diameter. Pl. 7, Fig. 10,11.

CZ–214. Plankton, Rio Chagres, Juan Mina.

PROTOMASTIGINEAE

Proteriodendron petiolatum var. **Abbottii** (Stokes) Playf.

Lorica vase-shaped, narrowed below to a long, spine-like base, one or two loricas arising from one below to form short branching chains; 6.8 μ in diameter, 15 μ long without stipe, 34 μ long with stipe. Pl. 7, Fig. 16.

CZ–206. Juan Mina, Rio Chagres.

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Wild Flowers of Western Pennsylvania and the Upper Ohio Basin. Volumes I and II. Text by *O. E. Jennings*, Watercolors by *Andrey Avinoff*. University of Pittsburgh Press, Pittsburgh. First edition limited to 3,000 copies, 1953. Vol. I, Text lxxv+575 pp.+150 maps. Vol. II, xvi+200 color plates+explanations. $60.00 the set.

Wild Flowers of Western Pennsylvania and the Upper Ohio Basin is one of the most remarkable botanical publications of all time. It is the result of the life work and planning of a highly competent, Ohio-born botanist, Otto E. Jennings, cooperating with the Russian-born artist and entomologist, Andrey Avinoff, director of the Carnegie Museum for nineteen years. These volumes, however, would not have been possible without the support of the Carnegie Institute, the University of Pittsburgh and The Buhl Foundation of Pittsburgh, who enabled the University of Pittsburgh Press to publish this monumental work for the public at a price far below the cost of printing.

The format of both volumes are masterpieces of design. The type face is of the beautiful Janson monotype. The paper was specially made for durability and opacity for type and appropriate to watercolor technique. The book page is 10¼″ x 14″, allowing for the plant illustrations to be life-size and for adequate spacing. The process used in reproduction of the watercolor plates was the Sheet-fed Gravure of the Beck House in Philadelphia. The binding is washable, durable, gray-green linen, stamped with gold, and shows top skill in its manufacture.

The Flora covers parts of six states, including western Pennsylvania, southwestern New York, northeastern Ohio, Maryland, Virginia and West Virginia. Volume I, the descriptive text gives accurate information for 2,260 species and 541 of their varieties and forms, including 135 plant families—nearly half of the 300 flowering plant families known for the world—and 706 genera. Habitat descriptions, range of distribution from counties in the regional range studied to international, and complete keys help to identify the species. Distribution maps show where 146 rare flowering plants and those with distinctive range pattern are to be found in the six states. This study, made by Dr. Jennings, is one of the most comprehensive ever made for a single botanical region.

Volume II is composed of 200 plates which are life-size gravure reproductions of the original watercolor illustrations of 253 species of flowering plants, painted by Dr. Avinoff. The paintings are quite lifelike and accurately done in great detail. They were made from living specimens collected and selected by Dr. Jennings. It has been predicted by Dr. Gordon Bailey Washburn, Director of Department of Fine Arts, Carnegie Institute, that "The time will surely come, as it already has with Audubon's great folios, when the plates alone will be framed as works of art".

GLENN W. BLAYDES

AN AUDIBILITY CURVE FOR TWO RING-NECKED PHEASANTS

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It was observed during World War I that ring-necked pheasants, *Phasianus colchicus* Linnaeus, seemed to be greatly disturbed by sounds which were inaudible to human ears (Leedy and Hicks, 1945). This observation suggested that perhaps an ultrasonic sound could be used to flush these birds ahead of the mowing machine. During 1953 an experiment was conducted in the Ornithological Laboratory at The Ohio State University to determine whether or not the ring-necked pheasant actually can hear ultrasonic sounds. Earlier attempts to ascertain the auditory thresholds of the ring-necked pheasant had been made by Trainer (1946) and Dowling (1952). These investigators attempted to condition pheasants to move from one end of their cages to the other end in response to the sounding of a tone followed by an electrical shock treatment. Both workers were unable to condition their subjects to give the desired response. Dowling, using pheasant chicks, was reasonably sure, however, that his birds were responding to signals up to 12,000 cycles per second.

EQUIPMENT AND TECHNIQUES

The birds used in this experiment were confined in a reasonably sound proof chamber when the hearing tests were being made. This chamber was constructed by inclosing a refrigerator shell in a large box so that the refrigerator shell was surrounded with a six-inch layer of sawdust. The sides and ceiling of the chamber were covered with ten or more sheets of burlap, and the floor was covered with a layer of damp sawdust. A wire grill was placed on the floor of the chamber. This grill was connected to the negative pole of a B Battery outside the chamber. A second wire, attached to the bird's leg above the heel joint, was touched against the positive pole of the B battery when it was desired to administer shock. The various wires passed through a small pipe in the wall of the chamber. An eight-inch Permoflux high fidelity speaker was mounted in the center of the ceiling of the chamber. The tones were generated with a Grason-Stadler audio-oscillator. The intensity at which the tones were presented was measured with a Hermon Hosmer Scott sound level meter, the microphone of which was placed near the usual position of the bird's head. The wave forms of the tones at the determined thresholds were examined with a Triplet oscilloscope.

The birds were in complete darkness when confined in the sound chamber, and they seldom moved in the absence of controlled stimuli. Observation of this fact suggested that perhaps the birds could be conditioned to give a simple movement in response to the sounding of an auditory signal. Through a conditioning period, a clearly audible tone was sounded and the birds were shocked if they did not otherwise give a reasonably vigorous jump within ten seconds after the tone was started. The insulated shock wire attached to the bird's leg was held in the operator's hand, and this was used to communicate information of the bird's movements to the outside of the sound chamber. The hand holding the wire was held firmly against the side of the chamber, and it would seem that the possibility of a secondary cue associated with the starting of the tone was thoroughly eliminated.

In order to avoid conditioning the birds to a given sound, the frequency and intensity of the tone was occasionally changed through the training period. The training program was continued until the birds were responding without shock about half of the times the tone was sounded. This point was reached by the

two hen pheasants after 420 and 580 training treatments, respectively. After the 50 percent level of proficiency had been attained, test treatments were initiated. A continuation of the training treatments was made necessary by the fact that there was considerable variation in proficiency shown at different times. The test treatment consisted in the sounding of a weaker tone than that given in the training treatment. The presence or absence of responses to the test treatments was noted, but the bird was not shocked in the event of a failure to respond.

Twenty-five training treatments were given along with 25 test treatments at each oscillator setting. The test and training treatments were presented in a sequence specified by the Gellerman randomized series. The number of responses in the 25 test treatments was compared with the number of responses in the 25 training treatments. The chi-square test for independence in a two-way classification was used to ascertain the extent of similarity in the two treatments. Similarity was based on the 5 percent level of significance. As the interval of time during treatments was approximately equal in both treatments, false responses, or responses given independently of the stimuli, are considered equally probable in the test and training treatments. Tests were made at given tone frequencies with only intensities changed in two decibel steps until a single change of intensity was followed by a noticeable difference in the number of responses in the test and training treatments.

RESULTS

An attempt was first made to determine the upper and lower auditory thresholds of the ring-necked pheasant in regard to tone frequencies. Tests were then made at the various frequencies for which the hearing of college freshmen is tested by the Department of Speech and Hearing at The Ohio State University. This is at 125, 250, 500, 1,000, 2,000, 4,000, and 8,000 cycles per second. In addition, intensity thresholds were established at 9,000, 9,500, and 10,000 cycles per second. Intensity thresholds were established for two birds at several of the same tone frequencies, and thresholds were the same in each case. After the intensity thresholds were established at several different frequencies, intermediate points could usually be predicted with a reasonable degree of accuracy. Unfortunately, one well conditioned bird was accidentally killed before thresholds had been determined at all of the frequencies proposed.

It is unfortunate that additional tests were not conducted at 125 cycles per second. While a low value of chi-square was obtained in one series of tests, a very low proficiency is shown by the fact that only two responses were given to 25 clearly audible sound stimuli (table 1). The validity of the test is considered questionable if the expected values do not exceed five. It seems best to disregard the results obtained at 125 cycles per second, as they are supported by only these two responses. A somewhat similar situation occurred at 8 decibels and 500 cycles per second, but in this case significant values of chi-square were obtained in five series of 25 tests at higher tone intensities. This low value of chi-square is neglected because it is based on only one response in 25 test treatments. This single response is considered a false response. A significant value for chi-square was also obtained in one series of treatments at 18 decibels and 500 cycles per second, but the threshold at 16 decibels is supported by two series of test treatments. In one series of tests, a significant value of chi-square was obtained at 10,000 cycles per second and 12 decibels intensity, while another series of tests at this point gave a non-significant value of chi-square. The test with the significant value was the first of the 42 series of tests conducted, and it was made before the technique was well-formed. It may thus be ignored.

Pure tones could not be generated with the available equipment at frequencies below 120 cycles per second, and it was not possible to determine the lower auditory threshold of ring-necked pheasants. As determined by an oscilloscope, there

was no visible distortion in the wave forms of all the tones where the data were accepted. Only one response was given in 75 test treatments at 11,000 cycles per second and at the maximum intensity generated by the oscillator. This single response must be regarded as a false response. The upper auditory threshold

TABLE 1

Responses of Two Ring-necked Pheasants in 25 Test Treatments Compared with 25 Training Treatments at Various Oscillator Settings

Band No.	Frequency in cps	Db above background	Responses in training treatments	Responses in test treatments	Chi-square values*
2150	125	6	10	3	7.02
2150	125	8	2	2	0.0
2150	250	9	12	4	5.88
2150	250	11	9	8	0.09
2150	500	4	13	0	17.57
2140	500	4	10	1	9.44
2150	500	6	15	1	18.01
2150	500	6	15	0	21.43
2140	500	8	5	1	3.03
2150	500	8	12	2	9.92
2150	500	10	15	1	18.01
2150	500	12	12	0	15.79
2150	500	14	11	0	14.10
2150	500	14	9	1	8.00
2150	500	16	10	5	2.38
2140	500	16	9	6	0.86
2140	500	18	13	6	4.16
2150	500	20	10	9	0.08
2150	500	22	10	10	0.0
2140	1,000	12	9	0	10.98
2140	1,000	14	5	4	0.14
2150	2,000	8	6	1	4.15
2150	2,000	10	7	5	0.44
2150	4,000	5	4	0	4.35
2150	4,000	7	7	8	0.10
2150	8,000	7	9	2	5.71
2150	8,000	9	4	8	1.75
2150	9,000	8	11	1	10.96
2150	9,000	10	9	6	0.86
2140	9,500	5	11	2	8.42
2140	9,500	7	10	5	2.38
2140	10,000	6	7	0	8.14
2140	10,000	8	7	5	0.44
2140	10,000	12	9	4	2.60
2150	10,000	12	13	0	17.57
2140	10,000	14	3	3	0.0
2150	10,000	14	6	3	1.22
2140	10,500	17	8	1	6.64
2140	10,500	19	10	9	0.08
2140	11,000	19	6	0	6.82
2140	11,000	21	4	0	4.35
2150	11,000	23	12	1	12.58

*Chi-square values exceeding 3.84 significant at 5 percent level.
Chi-square values exceeding 6.63 significant at one percent level.

was determined to be 10,500 cycles per second at an intensity of 19 decibels above the average background noise. An audibility curve for the two ring-necked pheasants is presented in figure 1. Thresholds were established at each of the points indicated by small circles. While Dowling's (1952) birds gave responses at frequencies up to 12,000 cycles per second, it should be noted that he used chicks

instead of adult birds as were used in this study. The results of the two studies, therefore, are not directly comparable.

SUMMARY

A shock avoidance technique was used to test the auditory acuity of two ring-necked pheasants. An audibility curve is presented for these birds. It was not possible, with the available equipment, to generate harmonic-free tones below 120 cycles per second, and the lower auditory threshold could not be determined. The upper auditory threshold was established at 10,500 cycles per second at an intensity of 19 decibels above the average background noise.

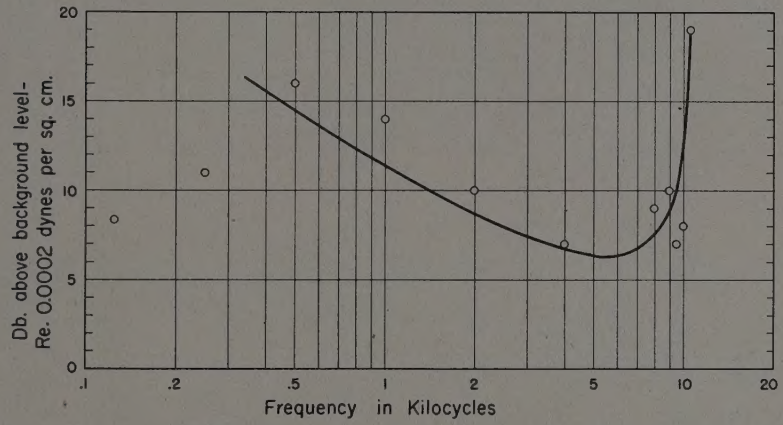

FIGURE 1. Audibility Curve for Two Ring-necked Pheasants (The curve has been fitted visually through empirical points).

ACKNOWLEDGMENTS

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Dowling, P. B. 1952. A determination of the audio-behavior thresholds of certain gallinaceous birds. M.Sc. Thesis. Pennsylvania State College, State College.

Leedy, D. L., and **L. E. Hicks.** 1945. The pheasants in Ohio. In W. L. McAtee, ed. Ring-necked pheasant and its management in North America. The American Wildlife Institute, Washington, D. C. p. 57–130.

Trainer, J. E. 1946. The auditory acuity of certain birds. Ph.D. Diss. Cornell University, Ithaca.

BOOK NOTICES

Geography in the Twentieth Century. *Griffith Taylor*, Editor. Philosophical Library, N. Y., Methuen, London. Second Edition, 1952. xiv+661 pp. $8.75.

Twenty-two authors and the editor have combined their talents to present in 28 chapters, a great variety of geographical subjects. Part I consisting of six chapters is philosophical in character; Part II consisting of 10 chapters is concerned chiefly with the environment; and Part III containing 12 chapters treats of the special fields of geography.

The professional geographers will find in this volume a wide range of familiar concepts and subjects. The thought-provoking and challenging ideas of the editor are set forth in the six chapters that he contributed to the book. In this single volume there is a brief review of the French and German contributions to geographic science. Geomorphology, meteorology, climate and soils are discussed in a chapter devoted to each. A miscellany of subjects, such as the tropics, urban geography, cartography, aerial photography, settlements, regionalism, and many others are presented briefly.

The scientific and lay reader will find here a cross-section of the field of geography presented authoritatively and clearly. Another editor and a different group of authors probably would have had a different series of chapters but the undercurrent of geographical ideas would have been similar if not identical.

GUY-HAROLD SMITH.

The Improved Nut Trees of North America and How to Grow Them. *Clarence A. Reed* and *John Davidson*. Devin-Adair Company, Publishers, New York. 1954. xxv+404 pp. $6.00.

It is a joy to find a book that is filled with the rich experiences of two authors that have lived long useful lives. Mr. Davidson wrote in his preface that Mr. Reed, "... is here no more." and now the same can be said of Mr. Davidson who died August 10 of this year, just a few days before this book was released.

Nut production both as a business and as a diversion from the routine task of earning a living has enjoyed much popularity in North America and this attractively printed and illustrated book will accelerate interest in this subject because of its scope which is so nicely indicated by its title. The style of writing is, I suspect, largely that of Mr. Davidson who was, this reviewer happens to know, a Unitarian minister, author, artist, business man, farmer and nut tree grower. With the author's successful careers in so many fields as a background it is not surprising that the text is both entertaining and informative for the beginner with nut trees as well as for the serious student of farming, horticulture, forestry, or wildlife conservation. This book will be an excellent source of information for years, and amateurs who desire to plant nut trees will find much practical information, at the price of a tree or two, that will enable them to avoid common errors and spend wisely of their labor and money. The reader will get a correct appreciation of an important subject and because this book is fine literature he will enjoy every minute of his educational experience.

CARL VENARD

Introductory Plant Science. *Henry T. Northen*. Ronald Press Company, New York. 1953. vi+601 pp. $5.50.

This general botany contains the most interesting and challenging collection of photographs and illustrations the reviewer has seen in such a volume. The organization of the material is skillful and usable though it would not suit all botanists. Whose plan of presentation of the plant sciences could be universally acceptable? Food manufacture for example stops with photosynthesis. There is a fairly long break before fat and protein syntheses appear in a chapter headed metabolism. While this is concise, it has some other disadvantages.

Coverage of the subject is good. The author has a pleasing way of interpolating a salient fact here and there that makes lively reading and combines excellently to point up the illustrations. There is no mention of laboratory work or of field work in the text as it appears not to be the fashion to make a complete class book out of an introductory work. The section on ecology and conservation would be much improved were the value of field studies brought in at this point.

A word that has wide use but is particularly annoying to the reviewer is *ovary* for *ovulary*. But this is not enough to detract from the value of the book as a whole upon which both publisher and author deserve congratulations.

A. E. WALLER

ENROLL A NEW MEMBER

The Ohio Academy of Science was organized on December 31, 1891, at Columbus, was incorporated on March 12, 1892, and became affiliated with the American Association for the Advancement of Science early in 1920. Its membership has grown from 59 charter members to more than 1200. The membership is representative of the educational and scientific institutions of the State and includes quite a number of persons outside the State.

AIMS—According to the Constitution: "The objectives of this Academy shall be the stimulation of interest in the sciences, recognition of merit, promotion of research, improvement of instruction in the sciences, and the dissemination of scientific knowledge." In addition to research and publication, the Academy aids in securing legislation which is favorable to scientific projects, as conservation, topographic and geologic survey, and in other important scientific projects.

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B—Plant Sciences	F—Geography	I —Anthropology & Sociology
C—Geology	G—Chemistry	J —Conservation
D—Medical Sciences		

MEETINGS—Annual meetings are held at a time and place fixed by the Executive Committee and the Council on the basis of invitations extended by educational institutions presented at the previous annual meeting. A regional plan is followed, so all areas of the state are covered over a period of several years. In addition to the program of scientific addresses and papers, field trips are frequently arranged.

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INFORMATION—Requests for information concerning any part of the Academy program should be addressed to the Secretary, who will either send a reply or will forward the request to the proper person for reply. The current Secretary is:

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